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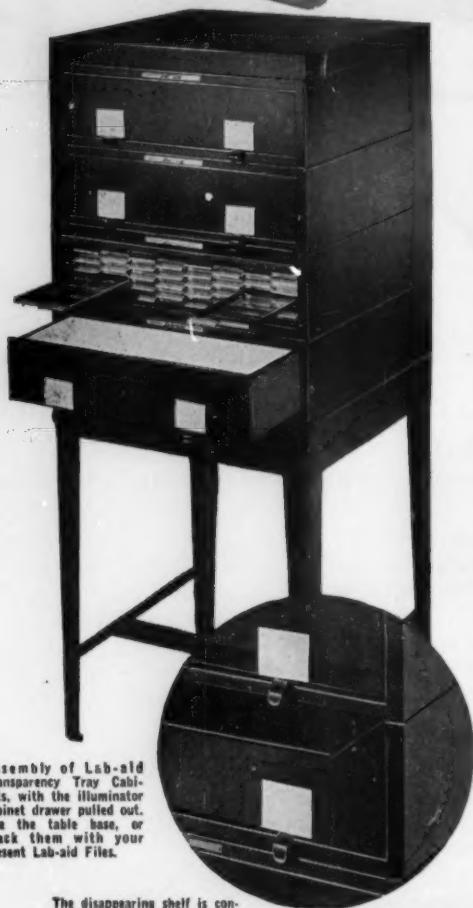
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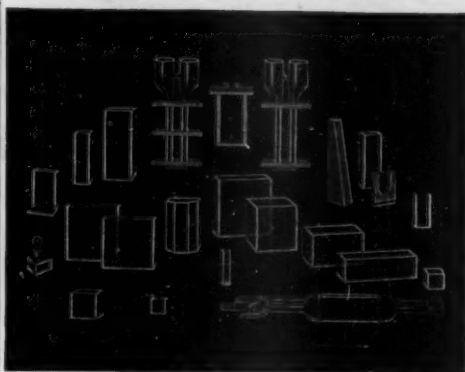
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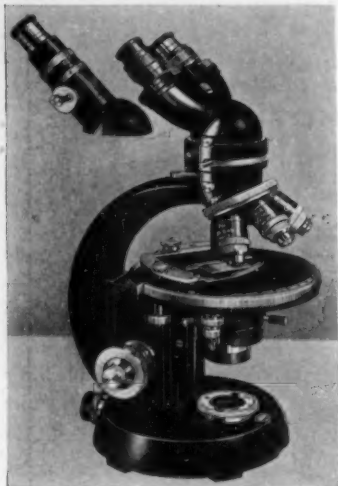
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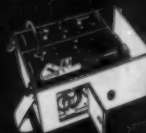
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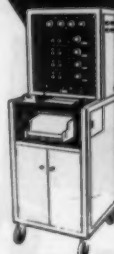
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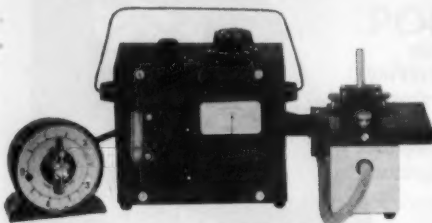
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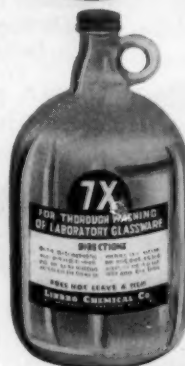
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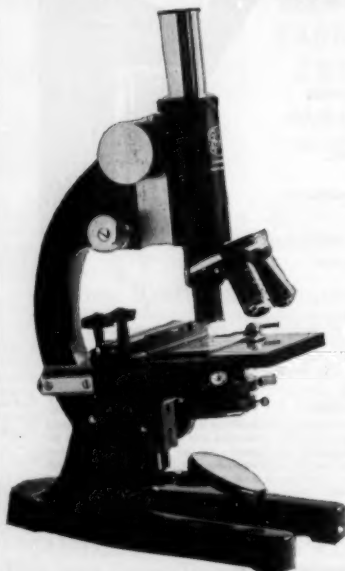
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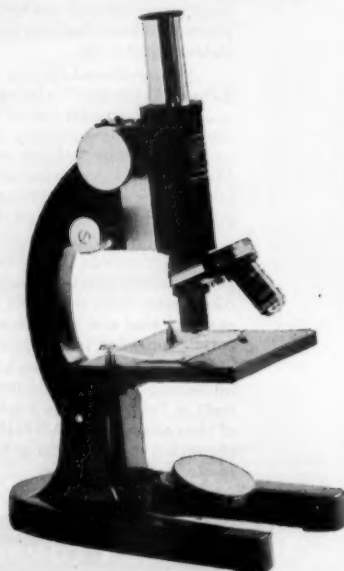
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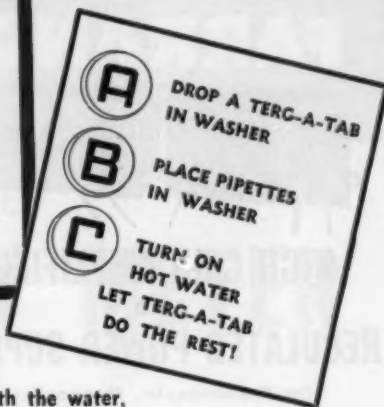
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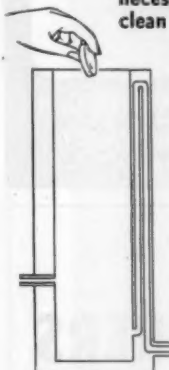


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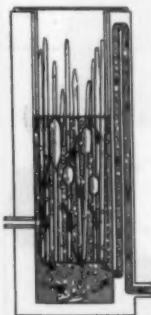
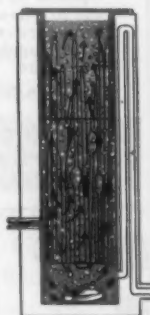
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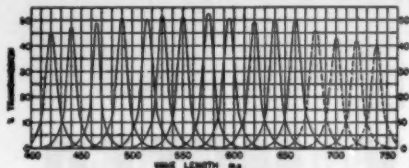


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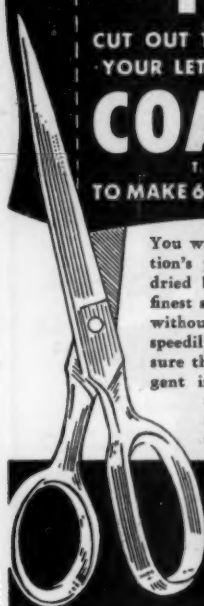
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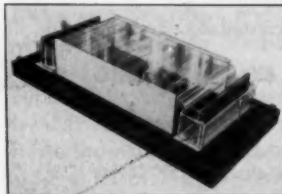
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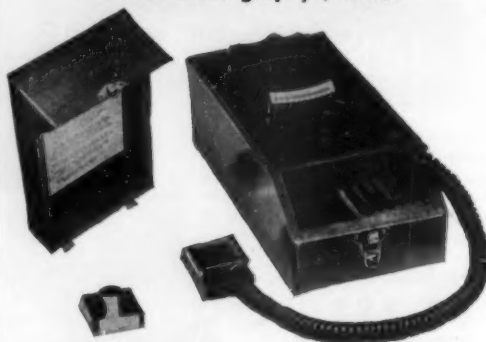
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Science and Poetry

WITH several pages of this issue devoted to communications on science and poetry, *Science* for good measure is reprinting here—by permission of the author and the publisher—two stanzas from Phyllis McGinley's 17-stanza poem, "In praise of diversity," taken from her latest book of light verse, *The Love Letters of Phyllis McGinley* (Viking Press, 1954). We have not checked, but this may well be the first time that verse has appeared on an editorial page of *Science*. However, this would seem strange in view of the role that great poetry of the past has played in communicating to people new scientific points of view, concepts, generalizations, and even whole conceptual schemes.

There's white, there's black; no tint between.

Truth is a plane that was a prism.

All's Blanshard that's not Bishop Sheen.

All's treason that's not patriotism.

Faith, charity, hope—now all must fit

One pattern or its opposite.

*Or so it seems. Yet who would dare
Deny that nature planned it other,
When every freckled thrush can wear
A dapple various from his brother,
When each pale snowflake in the storm
Is false to some imagined norm?*

This example of "light" verse alone might suffice for evaluating some of the issues raised in the communications. For instance, does it have scientific content in that a conception fundamental in present-day science is presented? If so, is this conception one that should be held by all people to the extent that it profoundly affects their thought and action? Does the verse enrich the conception and then express it in language that may serve to move many people in a way that the referential language of science might never move them? Does it matter whether or not Miss McGinley was deliberately or consciously writing "good science"? Good poets and good scientists have so many characteristics in common that the paths of their creative thought surely must often meet.—D.R.

Greater even than the greatest discovery is it to keep open the way to future discovery. This can only be done when the investigator freely dares, moved by an inner propulsion, to attack problems not because they give promise of immediate value to the human race, but because they make an irresistible appeal by reason of an inner beauty. . . . In short, there should be in research work a cultural character, an artistic quality, elements that give to painting, music and poetry their high place in the life of man.—JOHN JACOB ABEL.

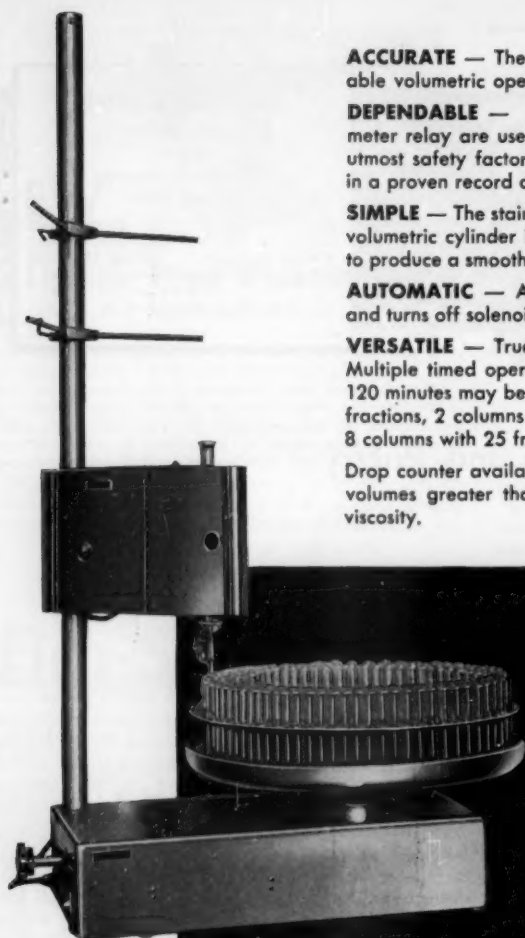
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Preview of the 121st Meeting, AAAS, Berkeley, California, 26-31 December 1954

AS was pointed out in previous announcements [*Science* 119, 780; 120, 509 (1954)], the 121st meeting of the American Association for the Advancement of Science, to be held on the Berkeley campus of the University of California, has grown to surprising proportions. Four years ago when the then executive committee of the Association decided to explore the possibilities of holding the first national winter meeting of the AAAS in the San Francisco Bay Area in 1954, it was assumed that most of the participating societies would be those that meet with the AAAS Pacific Division in June and that the attendance from east of the Rockies might be restricted to only a few hundred. Since then, however, a variety of other meetings—several international conferences and numerous national meetings, special regional meetings of national societies, and West Coast meetings of societies that usually do not meet with the AAAS, for example, the American Physical Society (estimated as 40 percent larger than last year's meeting), the Astronomical Society of the Pacific, and the Western Society of Naturalists—have combined to raise the total to 90 participating organizations, two-thirds of them with programs of their own. With the addition of the programs of the 18 AAAS sections, most of them also multisessioned and national in scope, there will be well over 300 sessions, and some 1500 papers will be read.

From such program details as the names and addresses of authors, advance registrations, and sleeping accommodation reservations, it is indicated that attendance from all sections of the continent and from abroad will be gratifyingly large. Not only will this year's AAAS meeting be the largest diversified scientific meeting ever held on the Pacific Coast, but it also will be one of the best attended in the history of the Association.

Despite the size and complexity of the meeting, however, each of the participating organizations will convene in its own set of session rooms, and their members will have their own social functions in addition to the opportunities to attend the special sessions, conferences, large-scale exhibits, AAAS Science Theatre, and other features associated with annual meetings.

As the list of participating societies and bare outline of sectional and societal symposiums show, no principal field of science will be neglected. The detailed daily Summary of Events indicates the extent to which the sections and societies have collaborated on joint interdisciplinary programs so characteristic of AAAS meetings, which bring together scientists of diverse specialties. Although a majority of the sessions are devoted either to short reports of current research or to technical symposiums, primarily of interest to specialists, there are many other symposiums, lectures, and addresses that will be of interest to the general attendance and the general public. And students at the high-school level have not been overlooked. A new feature this year is the broadening of the Junior Scientists Assembly, sponsored by the Association's Academy Conference, into a full afternoon for 850 selected high-school science students from the San Francisco Bay Area. This program, held on the campus of the cosponsor, San Francisco State College, will include addresses on opportunities in science and on scientific careers, respectively, by Warren Weaver, AAAS president, and Harry C. Kelley of the National Science Foundation, and other

events will be the General Electric Company's "House of Magic" and a special showing of two nature films supplied by courtesy of Walt Disney Productions.

Fundamental matters in education and in society will be emphasized in the AAAS Special Program, "The Crisis in Science Education," and in the three-part AAAS General Symposium, "Science and Society." The National Academy of Economics and Political Science has scheduled a symposium, "National Defense against Atomic Attack"; the National Association of Science Writers, another, on "Science and National Security." The vice-presidential address of Section K, given by John B. Condliffe, will be "The international consequences of scientific research"; the vice-presidential address of Section L, by Chauncey D. Leake, is "National loyalty and security in relation to scientific idealism."

1) **Contributed Papers.** Sessions for contributed papers are too numerous to catalog—but all principal fields of science are included. Papers in physics, in biology, in science teaching, and in such medical fields as experimental biology, biochemistry, and physiology, have had to be grouped in concurrent sessions. Of the 18 sections of the Association, the following 11 have sessions for contributed papers: A—Mathematics, C—Chemistry, D—Astronomy, E—Geology and Geography, G—Botanical Sciences, H—Anthropology, I—Psychology, L—History and Philosophy of Science, Nd—Dentistry, Np—Pharmacy, and Q—Education.

2) **Symposiums.** The details of the AAAS General Symposium, "Science and Society," appeared last month [*Science* 120, 766]. The combined list of the 105 symposiums of the sections and societies—including groups of invited papers (and some panels) devoted to a single theme—totals 126 sessions and more than 600 individual speakers.

3) **Vice-Presidential Addresses.** There will be vice-presidential addresses given by the following AAAS sections: D, E, F, G, I, K, L, N, P, Q.

4) **Conferences.** The three recurrent conferences at annual meetings of the Association have important programs in their areas. The *Academy Conference*, representing 42 academies of science affiliated with the AAAS, has a full day of sessions, 27 Dec. The *Conference on Scientific Editorial Problems*, meeting for the third time, has expanded its program, 29–30 Dec., to four sessions: I. Preparation of Technical Manuals for Complex Instruments. II. Effective Technical Writing. III. Scientific Journals. IV. Military and Industrial Technical Reports. The *Conference on Scientific Manpower*, meeting for the fourth year on an organized basis, has morning sessions on 28 and 29 Dec. on, respectively, "Implications of the Findings of the Commission on Human Resources and Advanced Training," and "Prospective Developments in the Utilization of Scientists and Engineers."

Special conferences, unique this year, are (1) The *International Conference on Animal Venoms*, organized by Nandor Porjes, Eastern Regional Research Laboratory, USDA, and jointly sponsored by AAAS Sections F—Zoological Sciences and N—Medical Sciences; it has eight sessions, 27–30 Dec. inclusive, and its 65 papers will be presented by speakers from all sections of the United States and from Aden, Australia, Austria, Brazil, Formosa, France, Germany, India, Italy, North Africa,

Switzerland, Thailand, and the Union of South Africa. (ii) The *Third Berkeley Symposium on Mathematical Statistics and Probability*, held every 4 or 5 years under the auspices of the Statistical Laboratory of the University of California. Jerzy Neyman, director, has arranged a full program, 28-31 Dec. inclusive. In addition to pure mathematics and statistics, there are sessions on applications to astronomy, biology and genetics, psychology, and medicine and public health. (iii) The *Pacific Slope Biochemical Conference*, arranged by David M. Greenberg, University of California, Berkeley, has four sessions of 48 contributed papers, 30 Dec.

5) **Special Sessions.** The details of the annual illustrated lecture of the National Geographic Society and of the evening addresses of the Scientific Research Society of America, the Society of the Sigma Xi, and of the United Chapters of Phi Beta Kappa have recently appeared in *Science* [120, 765]. These special events, sponsored by organizations that meet regularly with AAAS, are joint with the Association and are open to the general public of the city where the meeting is held. An additional program this year is the afternoon address of the Pacific Science Board, 30 Dec.

6) **AAAS Business Sessions.** The board of directors of the Association will meet after breakfast in the Directors Room of the Men's Faculty Club of the University of California, at 9 A.M., Monday, 27 Dec. Dates and hours of subsequent sessions of the board of directors during the meeting will be decided at this first session.

The Council of the Association will meet Monday, 27 Dec., at 4 P.M. in Eshleman Auditorium. A second session of the council is scheduled for Thursday, 30 Dec., at 9 A.M. in the same room. All members of the council have been notified individually, and it is hoped that all can attend. Subjects to be considered by the council (in addition to the agenda prepared) usually are first brought before the board of directors through the administrative secretary. During the meeting, communications for the board of directors should be left at the Hotel Shattuck mail desk, addressed to Dr. Dael Wolfe.

All section chairmen and section secretaries will meet Thursday, 30 Dec., at 12 noon in the Town Room, Hotel Shattuck, for luncheon and a business session. Dael Wolfe and Raymond L. Taylor will be cochairmen.

7) **AAAS Science Theatre Programs.** The AAAS Science Theatre, a permanent feature of the Association's annual meeting, presents showing of the latest domestic and foreign scientific films—nearly all with sound—throughout the meeting period. Please note, in the following schedule, that programs are both repeated and transposed to increase the opportunities for those attending the sessions of the 121st meeting to see particular films. Most titles—but not all—will be shown twice. The Association is greatly indebted to all those who made these pictures and lent them for showing.

Location of the Science Theatre. The AAAS Science Theatre is on the same floor of the Gymnasium for Men as the Annual Exposition of Science and Industry. Take corridor at left of entrance from foyer.

Admission to the Science Theatre. The Science Theatre is a feature for the pleasure and information of all registrants attending the annual meeting; it is deemed well worth the considerable cost of projection. It cannot be for the casual passerby; thus admission is restricted to those who wear the AAAS Convention Badge.

Hours of the Science Theatre are 9 A.M. to 1 P.M. and 2 to 6 P.M. the four days, 27-30 Dec., inclusive.

PROGRAM 1

Monday, 27 Dec., 9 a.m. to 1 p.m.

- 1) *Time-Lapse Studies of Growing Trees.* William M. Harlow, State University of New York College of Forestry. Color. Sound. 11 min.
- 2) *The Continuity of Life: Asexual Reproduction.* Indiana University. Color. Sound. 10 min.
- 3) *Target Nevada.* Department of the Air Force. Color. Sound. 14 min.
- 4) *Autonomic Nervous System*, parts III and IV. J. E. Markee and R. F. Becker, Duke University. Color. Sound. 30 min.
- 5) *Man to Man.* Mental Health Film Board. Black and white. Sound. 30 min.
- 6) *Processing Taconite Ore.* E. W. Davis and University of Minnesota Audio-Visual Services. Black and white. Sound. 15 min.
- 7) *Looking for the Answers.* New York Zoological Society and McGraw-Hill Book Co., Text-Film Department. Color. Sound. 11 min.
- 8) *Clean Waters.* General Electric Company. Color. Sound. 25 min.
- 9) *The Bronchopulmonary Segments*, part I: *Anatomy and Bronchoscopy.* Chevalier L. Jackson, John Franklin Huber, and Charles Norris, Temple University, and Pfizer Laboratories. Color. Sound. 25 min.
- 10) *Ready for Sea.* Raytheon Manufacturing Company. Color. Sound. 14 min.
- 11) *The Continuity of Life: Characteristics of Plants and Animals.* Indiana University. Color. Sound. 10 min.
- 12) *Underwater Story.* British Information Services. Black and white. Sound. 20 min.

PROGRAM 2

Monday, 27 Dec., 2 p.m. to 6 p.m.

- 1) *Living Microscopic Blood Vessels: Normal and Pathological Conditions.* Brenton R. Lutz and George P. Fulton, Boston University. Color. Silent. 25 min.
- 2) *Photogeology—A New Look for Oil.* Geophoto Services, Denver. Color. Sound. 22 min.
- 3) *Age of Turmoil.* McGraw-Hill Book Co., Text-Film Department. Black and white. Sound. 20 min.
- 4) *Structure and Function of the Vestibular Apparatus.* Richard J. Blandau and Newton B. Everett, University of Washington. Color. Sound. 20 min.
- 5) *Insect Catchers of the Bog Jungle.* Copyrighted by William M. Harlow, State University of New York College of Forestry, Syracuse. Color. Sound. 11 min.
- 6) *Four Experiments in Hydraulics.* National Bureau of Standards. Color. Sound. 17 min.
- 7) *Warning in the Dark.* Institute of Psychology, Innsbruck; distributed by Kinesis, Inc., San Francisco. Black and white. Sound (in German). 11 min.
- 8) *Columbia Frontier.* Bureau of Reclamation, U.S. Department of the Interior. Color. Sound. 28 min.
- 9) *Hazards of Dental Radiography.* National Bureau of Standards and the American Dental Association. Color. Sound. 13 min.
- 10) *225,000-Mile Proving Ground.* Association of American Railroads. Color. Sound. 20 min.
- 11) *Mosquito Stages of Plasmodium Falciparum.* Communicable Disease Center, U.S. Public Health Service. Black and white. Sound. 9 min.
- 12) *The Locomotion of Snakes.* New York Zoological Society; distributed by McGraw-Hill Book Co. Color. Sound. 11 min.

PROGRAM 3

Tuesday, 28 Dec., 9 a.m. to 1 p.m.

- 1) *CaCO₃*. Gardner-Denver Company and Black White Limestone Company, Quincy, Ill. Color. Sound. 23 min.
- 2) *The Physiology of Reproduction in the Rat*. Richard J. Blandau and Anthony Canedo, University of Washington. Color. Sound. 20 min.
- 3) *In the Beginning*. General Petroleum Corporation, distributed by Frank Church Films, Oakland, Calif. Color. Sound. 28 min.
- 4) *Which Fate?* National Society for Medical Research. Color. Sound. 21 min.
- 5) *Coaxial and Microwave Miracles*. The Bell Telephone System. Black and white. Sound. 10 min.
- 6) *Ancylostoma Caninum in the Intestine of the Dog*. Communicable Disease Center, U.S. Public Health Service. Black and white. Sound. 5 min.
- 7) *The Atomic Apothecary*. Medical Film Guild, Ltd. Black and white. Sound. 38 min.
- 8) *Hurricane Hunters*. U.S. Department of the Air Force. Black and white. Sound. 15 min.
- 9) *Syngamy and Alternation of Generations in Allogamyces—A Watermold*. Arthur T. Brice, Phase Films. Black and white. Sound. 20 min.
- 10) *Pumicelands*. New Zealand Embassy. Black and white. Sound. 22 min.
- 11) *Exit Grasshoppers*. Shell Chemical Corporation. Color. Sound. 10 min.

PROGRAM 4

Tuesday, 28 Dec., 2 p.m. to 6 p.m.

- 1) *The Fight: Science against Cancer*. National Film Board of Canada and Association of American Medical Colleges; distributed by International Film Bureau, Inc. Black and white. Sound. 21 min.
- 2) *The Dances of the Bees*. Karl von Frisch; distributed by E. J. Mauthner, New York. Black and white. Silent. 22 min.
- 3) *The Transistor*. The Bell Telephone System. Black and white. Sound. 10 min.
- 4) *Life in a Garden*. Roy Wilcox Productions and American Museum of Natural History; distributed by McGraw-Hill Book Co. Color. Sound. 13 min.
- 5) *The Atom Goes to Sea*. General Electric Company. Black and white. Sound. 12 min.
- 6) *Infective Larvae of Ancylostoma Caninum*. Communicable Disease Center, U.S. Public Health Service. Black and white. Sound. 4 min.
- 7) *World at Your Feet*. National Film Board of Canada; distributed by International Film Bureau, Inc. Color. Sound. 22 min.
- 8) *Fossil Story*. Shell Oil Company. Color. Sound. 19 min.
- 9) *Operation Blue Jay*. Department of the Army. Black and white. Sound. 28 min.
- 10) *Nuclear Reactors for Research*. North American Aviation, Inc. Color. Sound. 16 min.
- 11) *Citrus Culture*. Paul Hoefer Productions. Color. Sound. 17 min.
- 12) *Phase Microscopy of Normal Living Blood*. Richard J. Blandau, Quinn B. DeMarsh, and Paul H. Ralph, University of Washington. Black and white and color. Sound. 25 min.

PROGRAM 5

Wednesday, 29 Dec., 9 a.m. to 1 p.m.

- 1) *Underwater Story*. British Information Services. Black and white. Sound. 20 min.

- 2) *The Continuity of Life: Characteristics of Plants and Animals*. Indiana University. Color. Sound. 10 min.
- 3) *Ready for Sea*. Raytheon Manufacturing Company. Color. Sound. 14 min.
- 4) *The Bronchopulmonary Segments, part I: Anatomy and Bronchoscopy*. Chevalier L. Jackson, John Franklin Huber, and Charles Norris, Temple University, and Pfizer Laboratories. Color. Sound. 25 min.
- 5) *Clean Waters*. General Electric Company. Color. Sound. 25 min.
- 6) *Looking for the Answers*. New York Zoological Society and McGraw-Hill Book Co., Text-Film Department. Color. Sound. 11 min.
- 7) *Processing Taconite Ore*. E. W. Davis and University of Minnesota Audio-Visual Services. Black and white. Sound. 15 min.
- 8) *Man to Man*. Mental Health Film Board. Black and white. Sound. 30 min.
- 9) *Autonomic Nervous System, parts III and IV*. J. E. Markee and R. F. Becker, Duke University. Color. Sound. 30 min.
- 10) *Target Nevada*. Department of the Air Force. Color. Sound. 14 min.
- 11) *The Continuity of Life: Asexual Reproduction*. Indiana University. Color. Sound. 10 min.
- 12) *Time-Lapse Studies of Growing Trees*. William M. Harlow, State University of New York College of Forestry. Color. Sound. 11 min.

PROGRAM 6

Wednesday, 29 Dec., 2 p.m. to 6 p.m.

- 1) *The Locomotion of Snakes*. New York Zoological Society; distributed by McGraw-Hill Book Co. Color. Sound. 11 min.
- 2) *Mosquito Stages of Plasmodium Falciparum*. Communicable Disease Center, U.S. Public Health Service. Black and white. Sound. 9 min.
- 3) *225,000-Mile Proving Ground*. Association of American Railroads. Color. Sound. 20 min.
- 4) *Hazards of Dental Radiography*. National Bureau of Standards and the American Dental Association. Color. Sound. 13 min.
- 5) *Columbia Frontier*. Bureau of Reclamation, U.S. Department of the Interior. Color. Sound. 28 min.
- 6) *Warning in the Dark*. Institute of Psychology, Innsbruck; distributed by Kinesis, Inc., San Francisco. Black and white. Sound (in German). 11 min.
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- 8) *Insect Catchers of the Bog Jungle*. Copyrighted by William M. Harlow, State University of New York College of Forestry, Syracuse. Color. Sound. 11 min.
- 9) *Structure and Function of the Vestibular Apparatus*. Richard J. Blandau and Newton B. Everett, University of Washington. Color. Sound. 20 min.
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- 11) *Photogeology—A New Look for Oil*. Geophoto Services. Denver. Color. Sound. 22 min.
- 12) *Living Microscopic Blood Vessels: Normal and Pathological Conditions*. Brenton R. Lutz and George P. Fulton, Boston University. Color. Silent. 25 min.

PROGRAM 7

Thursday, 30 Dec., 9 a.m. to 1 p.m.

- 1) *Exit Grasshoppers*. Shell Chemical Corporation. Color. Sound. 10 min.

- 2) *Pumicelands*. New Zealand Embassy. Black and white. Sound. 22 min.
- 3) *Syngamy and Alternation of Generations in Allostomycetes—A Watermold*. Arthur T. Brice, Phase Films. Black and white. Sound. 20 min.
- 4) *Hurricane Hunters*. U.S. Department of the Air Force. Black and white. Sound. 15 min.
- 5) *The Atomic Apothecary*. Medical Film Guild, Ltd. Black and white. Sound. 38 min.
- 6) *Ancylostoma Caninum in the Intestine of the Dog*. Communicable Disease Center, U.S. Public Health Service. Black and white. Sound. 5 min.
- 7) *Coaxial and Microwave Miracles*. The Bell Telephone System. Black and white. Sound. 10 min.
- 8) *Which Fate?* National Society for Medical Research. Color. Sound. 21 min.
- 9) *In the Beginning*. General Petroleum Corporation, distributed by Frank Church Films, Oakland, Calif. Color. Sound. 28 min.
- 10) *The Physiology of Reproduction in the Rat*. Richard J. Blandau and Anthony Canedo, University of Washington. Color. Sound. 20 min.
- 11) *CaCO₃*. Gardner-Denver Company and the Black White Limestone Company, Quincy, Ill. Color. Sound. 23 min.

PROGRAM 8

Thursday, 30 Dec., 2 p.m. to 6 p.m.

- 1) *Phase Microscopy of Normal Living Blood*. Richard J. Blandau, Quinn B. DeMarsh, and Paul H. Ralph, University of Washington. Black and white and color. Sound. 25 min.
- 2) *Citrus Culture*. Paul Hoefler Productions. Color. Sound. 17 min.
- 3) *Nuclear Reactors for Research*. North American Aviation, Inc. Color. Sound. 16 min.
- 4) *Operation Blue Jay*. Department of the Army. Black and white. Sound. 28 min.
- 5) *Fossil Story*. Shell Oil Company. Color. Sound. 19 min.
- 6) *World at Your Feet*. National Film Board of Canada; distributed by International Film Bureau, Inc. Color. Sound. 22 min.
- 7) *Infective Larvae of Ancylostoma Caninum*. Communicable Disease Center, U.S. Public Health Service. Black and white. Sound. 4 min.
- 8) *The Atom Goes to Sea*. General Electric Company. Black and white. Sound. 12 min.
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- 12) *The Fight: Science against Cancer*. National Film Board of Canada and Association of American Medical Colleges; distributed by International Film Bureau, Inc. Black and white. Sound. 21 min.

8) Societies and Organizations Participating in the Berkeley Meeting

A—Mathematics and Statistics

American Mathematical Society
American Statistical Association
Institute of Mathematical Statistics
Pacific Coast Committee on Social Statistics of the Social Science Research Council

Third Berkeley Symposium on Mathematical Statistics and probability

B—Physics

American Meteorological Society
American Physical Society
Sigma Pi Sigma

C—Chemistry

Alpha Chi Sigma
American Chemical Society, California Section
Pacific Southwest Association of Chemistry Teachers

D—Astronomy

Astronomical Society of the Pacific
Meteoritical Society

E—Geology and Geography

Arctic Institute of North America
Association of American Geographers, Pacific Division
Association of Pacific Coast Geographers
Division of Mines, State of California
Geological Society of America
National Geographic Society
National Speleological Society

F—Zoological Sciences

American Society of Ichthyologists and Herpetologists
Cooper Ornithological Society
Herpetologists League
International Conference on Animal Venoms
International Union for the Study of Social Insects, North American Section
Pacific Coast Entomological Society
Society of Systematic Zoology

FG—Biological Sciences

American Society of Limnology and Oceanography
American Society of Naturalists
Beta Beta Beta
Biometric Society, WNAR
Ecological Society of America
Ecological Society of America, Western Section
National Association of Biology Teachers
Society of General Physiologists
Western Society of Naturalists

G—Botanical Sciences

American Phytopathological Society, Pacific Division
American Society of Plant Physiologists, Western Section
Botanical Society of America, Pacific Section
Mycological Society of America

I—Psychology

Society for Research in Child Development
Western Psychological Association

K—Social and Economic Sciences

AAAS Committee for Social Physics
National Academy of Economics and Political Science
Pi Gamma Mu
Society for the Advancement of Criminology
Western Economic Association

L—History and Philosophy of Science

Philosophy of Science Association
Society for the Advancement of General Systems Theory

M—Engineering

American Society for Engineering Education, Pacific Southwest Section
Engineering Manpower Commission

N—Medical Sciences

Alpha Epsilon Delta
American Academy of Forensic Sciences
American Psychiatric Association
Bay Counties Veterinary Medical Association
Donner Laboratory of Biophysics and Medical Physics

Pacific Slope Biochemical Conference
 Society for Experimental Biology and Medicine, Southern California and Pacific Coast Sections
 Society of American Bacteriologists, Northern California and Hawaiian and Southern California Branches

Nd—Dentistry

American College of Dentists
 American Dental Association
 International Association for Dental Research, North American Division

Np—Pharmacy

American Association of Colleges of Pharmacy
 American College of Apothecaries
 American Pharmaceutical Association, Scientific Section
 American Society of Hospital Pharmacists

O—Agriculture

Society of American Foresters
 Western Society of Soil Science

Q—Education

AAAS Cooperative Committee on the Teaching of Science and Mathematics
 American Educational Research Association
 California Science Teachers Association, Northern Section
 International Council for Exceptional Children
 National Association for Research in Science Teaching
 National Science Teachers Association

X—General Sciences

AAAS Pacific Division
 Academy Conference
 American Geophysical Union
 American Nature Study Society
 California Academy of Sciences
 Conference on Scientific Editorial Problems
 Conference on Scientific Manpower
 National Association of Science Writers
 National Research Council of the National Academy of Sciences
 National Science Foundation
 Pacific Science Board
 Scientific Manpower Commission
 Scientific Research Society of America
 Sigma Delta Epsilon
 Society of the Sigma Xi
 United Chapters of Phi Beta Kappa

9) Symposiums of the Sections and Societies

Mathematics and Statistics

Applications of Poisson and Exponential Distributions to Physics and Industry
 Regional Unemployment Estimates
 Regional Indexes of Business Activity
 Reliability of Complex Systems
 The Meaning of Probability to the Engineer, Mathematician, and Physicist
 Design of Experiments in Fisheries Work
 Principle of Invariance
 Comparison of Experiments
 Statistics in Biology and Genetics
 Statistical Mechanics
 Statistics in Medicine and Public Health
 Mathematical Statistics
 Statistics in Industrial Research
 Statistics in Psychology

Meteorology

Fire Weather Problems and Objective Forecasting

Microclimatology
 Weather Modification

Physics

High Energy Physics
 Theoretical Physics; two sessions
 Nuclear Chemistry
 High Energy Machines
 Nuclear Polarization
 Nuclear and Electron Resonance
 High Energy Electron Physics
 Division of Electron Physics
 Instrumentation

Chemistry

Petroleum Chemistry; two sessions
 Viruses
 Nucleic Acids and Nucleotides
 Chemistry in the Harnessing of Biological Resources; two sessions

Astronomy

Nebular Red Shift
 The Spatial Distribution of Galaxies
 The Distribution of Stars in the Hertzsprung-Russell Diagram

Geology and Geography

Science in the Arctic; five sessions
 Earth Sciences from the Air; two sessions

Zoological Sciences

Problems in Ecology of Amphibians and Reptiles
 Colony Organization and Related Processes in Social Insects
 Animal Courtship Patterns

Biological Sciences

Recent Advances in Biological Oceanography
 Marking Organisms in Ecological Studies
 Dew as an Ecological Factor
 Photochemical Effects in Biological and Biochemical Systems; two sessions
 Natural Resources of the West
 The Cell; two sessions

Botanical Sciences

Modern Views on Tissue Differentiation
 Crop Sequence and Plant Disease Control
 The Mode of Survival of Plant Pathogens in the Soil
 Physico-Chemical Control of Structural Differentiation in the Fungi

Anthropology

Culture Change in the Pacific Area; two sessions
 The Contribution of India-Pakistan Studies to Social Science Theory

Psychology

How Can Behavior Theory Best Handle the Construct of Motivation?
 Psychological Factors in Highway Safety
 The Nervous System and Behavior
 The Values and Limitations of Longitudinal Studies of Children
 Approaches to the Study of Personality Development in Children
 The Present Status of Psychoanalytic Theory
 Sex Differences in Personality and Intellectual Development
 Perception: Learned and Unlearned

Social and Economic Sciences

The Appraisal of Natural Resources Development
 Regional Economic Analysis
 The Social Structure of Cities
 Pacific Coast Population Trends
 The Organization of Research for Western Regional Development

National Defense Against Atomic Attack
Diffusion Theory; two sessions
Education in Criminology; two sessions
History and Philosophy of Sciences
Probability and Induction
Engineering
Air Pollution; two sessions
Industry's Stake in Engineering Education
Medical Sciences
Physiology of Growth—Normal and Abnormal; four sessions
Preparation for Medical and Dental Education in the Liberal Arts College; two sessions
Medical-Legal Aspects of Head Injuries
Clinical Applications of Chlorpromazine
Clinical Applications of Reserpine
Mechanism of Drugs with Behavioral Effects
Some Problems in the Care of Laboratory Animals
Infectious Disease Control in a Small Animal Hospital
Recent Advances in Biophysics and Medical Physics; two sessions
Adrenal-Pituitary Relationships
Dentistry
Growth and Development
Radiation Hazards in the Dental Office
Pharmacy
Hazardous Domestic Pesticides and Household Chemicals
Ways and Means of Improving Pharmacy Service
Administrative Responsibilities of the Hospital Pharmacist
Agriculture
Soil Management Problems in Western Agriculture
Water Supplies and Irrigation
Seed Production in the Western States
Problems in Horticultural Crops
Industrial Science
The Roles of Government, Industry, and the University in Basic Research; two sessions
Education and Science Teaching
Problems Relating to Reading
Problems in the Development of Educational Programs for Exceptional Children
Recent Research in the Development of Exceptional Children
Research in Science Education
The Crisis in Science Education; two sessions
Biology for Pleasure
Biology for Living
Biology for Survival
Our Biology Laboratory Problems
The Schools, Their Problems, and You
Keeping Up to Date in Science
Science Teachers Face Their Problems
Progress in Science Education
Science in General
Natural History as Revealed by Early Explorers in the West
Recent Scientific Explorations in the West and Their Contributions to Natural History
Science and National Security

BERKELEY MEETING INFORMATION

Hotel Headquarters. The Hotel Shattuck is the official headquarters of the AAAS; it is where messages for the board of directors of the Association should be left. The Press Room—for receipt of authors' abstracts and the

only source of press releases—is the office of the *Daily Californian* in Eshleman Hall.

The AAAS Registration-Information Center, the Visible Directory of Registrants, the AAAS Office, the AAAS Science Theatre, and the Annual Exposition of Science and Industry are in the Gymnasium for Men, Dana St.

Since virtually all sessions are on the campus, rather than in hotels, it has not been feasible to name any hotel in Berkeley as headquarters for particular sections or participating societies. To meet needs for headquarters rooms in some cases, the following have been assigned.

Headquarters rooms

All botanists	Life Sciences Building 2023
American Nature Study Society	Wheeler 203
American Physical Society	LeConte 375
Herpetologists League	Life Sciences Building 3598
National Association of Biology Teachers	Wheeler 303
National Science Teachers Association	Wheeler 100
Society of Systematic Zoology	

Stephens Memorial Room

Statisticians

Dwinelle 288

Western Society of Naturalists

Life Sciences Building 2609

Headquarters for women. The new Alumni House on Dana Street, directly across from the Gymnasium for Men, will serve as a lounge for all attending the AAAS meeting. It will be particularly convenient as a meeting place for husbands and wives and for visiting. A Supplementary Information Center, staffed by wives of the faculty of the University of California, will be located on the main floor, and light refreshments will be available.

Registration. The AAAS Registration-Information Center will be located in the lobby of the Gymnasium for Men, the entrance to which is on Dana Street. It will be open daily, 26–30 Dec., 8 A.M. to 9 P.M. except Thursday evening 30 Dec., when it will remain open until 11 P.M. to accommodate any nonregistrants who wish to attend the Biologists' smoker, and Friday, 31 Dec., when it will close at noon.

The Registration Center is the *only* place to receive a convention badge, the General Program-Directory, a map of the city, guide books, and other complimentary literature. Advance registrants (who receive Programs and badges prior to the meeting) are urged to visit the Registration Center at any convenient time, to receive these last-mentioned items.

Registration fee. The AAAS registration fee for all persons is \$2.50. Each registrant receives a receipt, a convention badge, and the General Program-Directory—the only publication with the programs of all 18 AAAS Sections and of the 90 participating organizations. Any person who purchases an advance copy of the General Program-Directory but does not register in advance and who then attends the meeting agrees to complete his registration—and is expected to do so—at the AAAS Registration Center, after which he will receive his convention badge and the privileges that go with it.

It is essential that each person who attends the meeting support it by paying the registration fee of \$2.50, which, intentionally, has been kept at a minimum. When the costs of the Program and badge are deducted, the net contribution toward general expenses is less than \$1 per registrant.

AAAS convention badge. The AAAS convention badge indicates that you have paid your share of the expenses of the meeting and that you are a complete participant in this 121st convention of the Association. The badge

should be worn throughout the meeting, because (i) it reminds others to register; (ii) it is needed for admission to the AAAS Science Theatre, the Biologists' Smoker, and the reception that follows the presidential address; and (iii) it helps others to find you.

The California Academy of Sciences will admit free to its new planetarium persons wearing the badge.

The badge will facilitate parking on the campus.

Visible Directory of Registrants. The much-consulted Visible Directory of Registrants, for the maximum convenience of all, is located between the Registration Center and the Annual Exposition of Science and Industry. The hours it will be open correspond exactly with the hours the AAAS registration is open—daily 8 A.M. to 9 P.M. The registration cards of all registrants are placed in the Visible Directory as soon as possible after registration. The arrangement is alphabetical. The cards of advance registrants are *completely* alphabetized and typed, since they were posted in Washington prior to the meeting; all other registration cards are filed to the second or third letter of the surname (Ba, Be, etc.). Members of the press, exhibitor personnel, and guests are included in the Visible Directory—on blue cards instead of yellow. Registrants will find the Visible Directory invaluable in determining the convention addresses of friends attending the meeting.

Mail, telegrams, and messages. Mail and telegrams addressed in care of the AAAS will be held at the AAAS Office in the Gymnasium for Men. Efforts will be made to notify addressees listed in the Visible Directory, but the Association assumes no responsibility for the delivery of mail or of telegrams.

Telephone and personal messages will be filed alphabetically in the AAAS Office, and the names for whom they are intended will be posted on a bulletin board.

Society meal function tickets. Tickets to the dinners or luncheons of any participating society are obtainable only from representatives of that society, during preceding sessions of that society, or at the AAAS Information Center.

Facilities for Eating. Throughout the meeting period, the University of California will serve low-cost meals in its cafeterias (four separate rooms accommodating 200 each); breakfasts in the dormitory units; and light refreshments in the Gymnasium for Men, the Alumni Hall Lounge, and Stephens Memorial Hall.

The Hotel Claremont serves all meals in one dining room; the Hotels Shattuck and Durant have both coffee shops and dining rooms. Some of the restaurants near the campus are Larry Blake's (American-German), 2367 Telegraph Avenue; Gladys's, 2451 Shattuck Avenue; Lichee Hwon (Chinese), 2500 Telegraph Avenue; The Black Sheep, 2550 Bancroft Way.

The names of other restaurants in Berkeley may be obtained at the Information Center.

Local Travel Directions. The campus of the University of California is so compact that all session rooms are within walking distance of one another and of the Hotels Shattuck and Durant. (The Hotel Claremont is 1 mi away.) From other parts of Berkeley, the campus is served by a variety of bus routes (fare 20c). Information on these routes and other travel data may be obtained at the Registration Center in the Gymnasium for Men.

Between Berkeley and San Francisco. By car, San Francisco and the campus area of Berkeley are about 12 mi apart—some 7½ mi of which is across the San Francisco Transbay Bridge and its approaches. Time (except at "rush hour") 20 min; bridge toll 25c.

Those who wish to visit San Francisco without a car may take a Key System interurban train from Shattuck and University Avenues or at stops on Shattuck Avenue at Bancroft Way or Dwight Way. Running time 30 min; fare 48c. From the Bay Terminal on First Street it is possible to go anywhere in San Francisco on one fare (15c) and a transfer, for example, Union Square, Chinatown, Nob Hill (via cable car), Fishermen's Wharf.

To return to the vicinity of the campus or to the Hotels Shattuck and Durant, take an "F" train from the Bay Terminal; for the Hotel Claremont, take an "E" train. Since the frequency of service varies from 30 min to 1 hr at night, consulting a timetable is advisable.

Tours. At this meeting there are no formal tours sponsored by the AAAS as a whole, but certain sections and societies have planned tours and field trips.

The California Academy of Sciences in Golden Gate Park will admit free to their new planetarium all who wear the AAAS convention badge. The adjacent large Museum and Steinhart Aquarium will also be of interest. The Academy is sponsoring an Open House for the Society of Systematic Zoology, Tuesday, 28 Dec., 2 to 6 P.M.

For the physicists, the Radiation Laboratory of the University of California has arranged one afternoon tour each day of the meetings. Visitors may sign up for the trips of their preferences at the APS Registration Desk in LeConte Hall.

The Division of Mines, State of California, Ferry Building, San Francisco, will guide one or more motoreades to points of geologic interest in the Coast Ranges and San Francisco Bay Area. It is desirable that those making this trip purchase in advance the 400-page publication, Bull. 154, *Geologic Guide Book of the San Francisco Bay Counties; History, Landscape, Geology, Fossils, Minerals, Industry, and Routes to Travel*, by Olaf P. Jenkins. Tour leaves Claremont Hotel parking lot, Tuesday, 28 Dec., at 8:30 A.M.

The Astronomical Society of the Pacific and AAAS Section D will make a trip to Lick Observatory, Mount Hamilton, Thursday, 30 Dec. They will be joined by the Meteoritical Society.

All-day field trips to Muir Woods (redwoods) and Stinson Beach State Park are scheduled by Ecological Society of America and Herpetologists League, Thursday, 30 Dec.; American Nature Study Society and National Association of Biology Teachers, Thursday, 30 Dec.

An expedition to the Institute of Forest Genetics, California Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture, Placerville, Calif., to observe experiments in progress, is being planned for Friday, 31 Dec., by the Third Berkeley Symposium on Mathematical Statistics and Probability. Departure from Berkeley may be the evening of 30 Dec., and also early on the morning of 31 Dec.

Tours for women. The wives of the faculty of the University of California and the women of the administrative staff have volunteered to conduct women visitors on tours around the campus and vicinity. Those who are interested should apply to the Supplementary Information Center in the Lounge of the Alumni House.

AAAS Public Information Service. Each person who will deliver an address or present a paper at the Berkeley meeting is requested to provide the Association's Public Information Service with 100 copies of a nontechnical abstract of his paper. One hundred copies of complete manuscripts are also required of papers presented by (i) officers of the Association; (ii) officers and invited speakers who appear on the programs of the participating

societies; and (iii) authors whose papers are particularly newsworthy. Most authors already have recognized the necessity of this procedure and have sent their material to the Association's Director of Public Information, Sidney S. Negus, Medical College of Virginia, Richmond, Va. If you are an author of an address or paper and have not done this, please send to Dr. Negus, to arrive in Richmond on or before 15 Dec., 100 copies of your nontechnical abstract and 100 copies of your full paper (or significant portions of it if it is unusually long). If it is impossible for you to send this material to Richmond to arrive by 15 Dec. (and mails are much slower in the pre-Christmas period), then mail all your material to Dr. Negus—or deliver it to him in person—at the AAAS Press Room, Eshleman Hall, Berkeley, before or during the convention. As an aid to the Association's Public Information Service, please send copies of your paper to your local newspapers with the time indicated when it is to be presented in Berkeley.

The necessity for the general public to be kept informed of the results of the scientific research which it supports, directly and indirectly, is quite evident. Organized science and the individual scientist must have the understanding and support of all. It is, of course, equally important that the advances of science be publicized with accuracy and clarity without sensationalism. Progress in this direction in recent years has been most gratifying, thanks largely to members of the National Association of Science Writers, other accredited science reporters, managing editors of American newspapers, and program managers of radio and television stations.

It is in the interest of accuracy and completeness that science writers frequently wish to discuss various research results with investigators. If you are asked to cooperate in this respect or to participate in a press conference, please do so, not only for your own protection, but for the benefit of science in general. Scores of science writers will be covering this meeting. News stories filed by the representatives of all the wire services will be published and broadcast throughout the entire civilized world. At no other scientific meeting are the facilities for the dissemination of the most recent findings in all branches of science so complete as they are at the great, diversified meetings of the AAAS.

This year, not only is the Association fortunate in the continued services of Dr. Negus, chairman of the Department of Biochemistry, Medical College of Virginia, Richmond, and past president of the Virginia Academy of Science, but also in its Local Committee on Public Information, headed by George C. Tenney, vice president, McGraw-Hill Publishing Company, San Francisco.

Berkeley Committees. As is rather generally recognized, it would be quite impossible to arrange successfully a large and complex meeting and to carry it through to a conclusion, successful in all respects, if it were not for the devoted services of many local scientists and other members and friends of the Association. They merit the unstinted appreciation of all who attend. It is noteworthy that Robert Gordon Sproul accepted the general chairmanship of the Berkeley meeting in the spring of 1953, appointed the local committees early, and has kept in close touch with all phases of this year's meeting. In making the 121st meeting a memorable one, those whose names follow have advanced science:

GENERAL CHAIRMAN

Robert Gordon Sproul, president, University of California, Berkeley

VICE CHAIRMEN

James B. Black, president, Pacific Gas & Electric Company, San Francisco
Robert K. Cutter, president, Cutter Laboratories, Berkeley

EXECUTIVE SECRETARY

George A. Pettitt, University of California, Berkeley

GENERAL COMMITTEE

Robert G. Sproul, president, University of California, chairman
Raymond B. Allen, Chancellor, University of California, Los Angeles
Stephen D. Bechtel, president, Bechtel Corporation, San Francisco
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SUMMARY OF EVENTS

Registration, the AAAS Annual Exposition of Science and Industry, the AAAS Science Theatre, and the Visible Directory of Registrants are daily events, although the hours may vary from day to day. These events are described in detail in preceding and later sections of this Preview of the Berkeley Meeting.

Sunday Afternoon, 26 Dec.

Mathematics and Statistics

Third Berkeley Symposium on Mathematical Statistics and Probability—3 P.M.; informal reception; 288 Dwinelle Hall

Chemistry

Section on Chemistry—2 P.M.; contributed papers; 100 Lewis Hall

Sunday Evening, 26 Dec.

Chemistry

Section on Chemistry—7 P.M.; contributed papers; 100 Lewis Hall

Monday Morning, 27 Dec.

AAAS as a Whole

AAAS board of directors meeting—9 A.M.; Directors Room, Men's Faculty Club
Academy Conference—9 A.M.; business meeting; 33

Dwinelle Hall. 10:30 A.M.; reports of committees; 33, Dwinelle Hall

International Conference on Animal Venoms, I—9 A.M.; 155 Dwinelle Hall

Mathematics and Statistics

American Statistical Association; Institute of Mathematical Statistics; Section on Mathematics—9:30 A.M.; Applications of Poisson and Exponential Distributions to Physics and Industry; 111 Dwinelle Hall

Third Berkeley Symposium on Mathematical Statistics and Probability; Section on Mathematics; American Statistical Association; Biometric Society, WNAE; Ecological Society of America; Institute of Mathematical Statistics—9 A.M.; Statistics in Biology and Genetics; 145 Dwinelle Hall

Chemistry

American Chemical Society, California Section; Section on Chemistry—9 A.M.; symposium: Petroleum Chemistry, I; Auditorium, Chemistry Building

Astronomy

Astronomical Society of the Pacific; Section on Astronomy—9 A.M.; papers; 1 Leuschner Observatory

Zoological Sciences

Society of Systematic Zoology—10 A.M.; council meeting I; Council Room, Stephens Union

Biological Sciences

Ecological Society of America and ESA, Western Section—9 A.M.; contributed papers; 159 Forestry Building

Society of General Physiologists—9 A.M.; contributed papers; 2507 Life Sciences Building

Western Society of Naturalists—9:15 A.M.; concurrent session 1; contributed papers: Physiology; 2503 Life Sciences Building. 9:15 A.M.; concurrent session 2; contributed papers: Vertebrate Natural History; 2003 Life Sciences Building

Psychology

Western Psychological Association; Section on Psychology—9 A.M.; symposium: The Present Status of Psychoanalytic Theory; 113, Haviland Hall

Society for Research in Child Development; Section on Psychology; Section on Education—9 A.M.; The Values and Limitations of Longitudinal Studies of Children; 123 Haviland Hall

Social and Economic Sciences

Section on Social and Economic Sciences; Section on Engineering—9 A.M.; symposium: The Appraisal of Natural Resources Development; B45 Dwinelle Hall

AAAS Committee for Social Physics—10 A.M.; Diffusion Theory, I; 15 Dwinelle Hall

Medical Sciences

Section on Medical Sciences—9 A.M.; symposium: Physiology of Growth—Normal and Abnormal, I; 101 California Hall

Society of American Bacteriologists, Northern California and Hawaiian and Southern California Branches—9:30 A.M.; contributed papers; 105 California Hall

Agriculture

Section on Agriculture; Western Society of Soil Science; American Geophysical Union—9 A.M.; symposium: Soil Management Problems in Western Agriculture; 125 Hilgard Hall

Education

Section on Education; American Educational Research Association—9 A.M.; joint session; 103 Wheeler Hall

National Science Teachers Association—9 A.M.; general session: The Schools, Their Problems, and You; Auditorium, Wheeler Hall. 10:15 A.M.; concurrent ses-

sion 1; discussion, Kindergarten through Grade 6; 11 Wheeler Hall. 10:15 A.M.; concurrent session 2; discussion, Grades 7 through 9; 30 Wheeler Hall. 10:15 A.M.; concurrent session 3; discussion, Grades 10 through 12; 110 Wheeler Hall

Science in General

American Nature Study Society—8 A.M.; meeting of board of directors; 203 Wheeler Hall. 9:30 A.M.; Natural History as Revealed by Early Explorers in the West; 311 Wheeler Hall

Monday Noon and Afternoon, 27 Dec.

For all women attending the AAAS meeting; Mrs. Robert Gordon Sproul and Mrs. Clark Kerr will entertain at a tea in the Women's Faculty Club, 3 to 5 P.M.

AAAS as a Whole

Academy Conference—2 P.M.; address; 33 Dwinelle Hall. 3 P.M.; reports from individual Academies; 33 Dwinelle Hall

International Conference on Animal Venoms, II—2 P.M.; 155 Dwinelle Hall

AAAS General Symposium—Science and Society, I: Natural Resources: Power, Metals, Food; 4 P.M.; Auditorium, Wheeler Hall

AAAS Council Meeting I—4 P.M.; Auditorium, Eshleman Hall

Mathematics and Statistics

American Statistical Association; Pacific Coast Committee on Social Statistics of the Social Science Research Council—2 P.M.; Regional Unemployment Estimates; 127 Dwinelle Hall

Institute of Mathematical Statistics; Biometric Society, WNAE—1:30 P.M.; Design of Experiments in Fisheries Work; 111 Dwinelle Hall

Institute of Mathematical Statistics; Third Berkeley Symposium on Mathematical Statistics and Probability—4 P.M.; special invited papers; 145 Dwinelle Hall

Physics

Third Berkeley Symposium on Mathematical Statistics and Probability; Section on Mathematics; Section on Physics; American Physical Society; American Statistical Association; Institute of Mathematical Statistics—1:30 P.M.; Statistical Mechanics; 145 Dwinelle Hall

Chemistry

American Chemical Society, California Section; Section on Chemistry—2 P.M.; symposium: Petroleum Chemistry, II; Auditorium, Chemistry Building

Astronomy

Astronomical Society of the Pacific; Section on Astronomy—1:30 P.M.; symposium: Nebular Red Shift; 1 Leuschner Observatory

Zoological Sciences

Society of Systematic Zoology—2 P.M.; symposium: Animal Courtship Pattern; 11 Wheeler Hall

Biological Sciences

Ecological Society of America and ESA, Western Section; Section on Zoological Sciences; Section on Botanical Sciences—2 P.M.; symposium: Marking Organisms in Ecological Studies; 159 Forestry Building

Western Society of Naturalists; Section on Chemistry; Section on Zoological Sciences; Section on Botanical Sciences; American Society of Plant Physiologists, Western Section—2 P.M.; invited papers: Photochemical Effects in Biological and Biochemical Systems, I; 2003 Life Sciences Building

Western Society of Naturalists—2 P.M.; contributed papers: Vertebrate Anatomy and Physiology; 2503 Life Sciences Building

Psychology

Western Psychological Association; Section on Psychology; Section on Education—2 P.M.; symposium: Sex Differences in Personality and Intellectual Development; 113 Haviland Hall

Society for Research in Child Development; Section on Psychology; Section on Education—2 P.M.; Approaches to the Study of Personality Development in Children; 123 Haviland Hall

Social and Economic Sciences

AAAS Committee for Social Physics—2 P.M.; Diffusion Theory, II; 15 Dwinelle Hall

History and Philosophy of Science

Society for the Advancement of General Systems Theory—2 P.M.; organizational meeting; B45 Dwinelle Hall

Medical Sciences

Section on Medical Sciences—2 P.M.; symposium: Physiology of Growth—Normal and Abnormal, II; 101 California Hall

Society of American Bacteriologists, Northern California and Hawaiian and Southern California Branches—2 P.M.; contributed papers: 105 California Hall

Agriculture

Section on Agriculture; Section on Geology and Geography; Section on Engineering; Western Society of Soil Science; American Geophysical Union—2 P.M.; symposium: Water Supplies and Irrigation; 125 Hilgard Hall

Education

Section on Education; American Educational Research Association—2 P.M.; joint session; 103 Wheeler Hall

Section on Education—2 P.M.; general papers; 102 Wheeler Hall

National Science Teachers Association—11:45 A.M.; luncheon program: This Is Your NSTA; Turquoise Room, University Cafeteria. 1:30 P.M.; concurrent session 1; Keeping Up to Date in Science; 30 Wheeler Hall. 1:30 P.M.; concurrent session 2; Keeping Up to Date in Science; 110 Wheeler Hall. 1:30 P.M.; concurrent session 3; Keeping Up to Date in Science; 120 Wheeler Hall. 4 to 6 P.M.; Science Teachers social mixer; Women's Social Room, Stephens Union

Science in General

American Nature Study Society—2 P.M.; Recent Scientific Explorations in the West and Their Contributions to Natural History; 311 Wheeler Hall

Monday Evening, 27 Dec.

AAAS as a Whole

Academy Conference—6:30 P.M.; Academy Conference dinner and presidential address; North Room, Men's Faculty Club

United Chapters of Phi Beta Kappa—Annual address; 8:30 P.M.; 155 Dwinelle Hall

National Geographic Society—Annual illustrated lecture; 8:30 P.M.; Berkeley High School Auditorium

Mathematics and Statistics

Institute of Mathematical Statistics—8 P.M.; council meeting; 117 Dwinelle Hall

Astronomy

Meteoritical Society—8 P.M.; meeting of 1950-54 council; Carlton Hotel

Zoological Sciences

Society of Systematic Zoology—8 P.M.; general lecture; 11 Wheeler Hall

Biological Sciences

Ecological Society of America and ESA, Western Sec-

tion—7 P.M.; Ecologists' dinner; place to be announced. (Purchase tickets in foyer of Gymnasium for Men.)

Social and Economic Sciences

National Academy of Economics and Political Science; Pi Gamma Mu; Section on Social and Economic Sciences—8 P.M.; symposium: National Defense against Atomic Attack; Auditorium, Eshleman Hall

Engineering

American Society for Engineering Education, Pacific Southwest Section—7:30 P.M.; committee meetings; 104, 125, 134, 204, 210, 286 Dwinelle Hall

Education

National Association of Biology Teachers—8 P.M.; meeting of executive board; 303 Wheeler Hall

Science in General

American Nature Study Society—8 P.M.; annual meeting of ANSS; 311 Wheeler Hall. 8:30 P.M.; annual showing of kodachromes; 311 Wheeler Hall

Tuesday Morning, 28 Dec.

AAAS as a Whole

Conference on Scientific Manpower—9 A.M.; I. Implications of the Findings of the Commission on Human Resources and Advanced Training; 104 Engineering Building

International Conference on Animal Venoms, III—9 A.M.; 155 Dwinelle Hall

Mathematics and Statistics

American Statistical Association; Pacific Coast Committee on Social Statistics of the Social Science Research Council—9:30 A.M.; Regional Indexes of Business Activity; 127 Dwinelle Hall

American Statistical Association—9 A.M.; Reliability of Complex Systems; B45 Dwinelle Hall

Institute of Mathematical Statistics; Third Berkeley Symposium on Mathematical Statistics and Probability—9 A.M.; Principle of Invariance; 111, Dwinelle Hall

Third Berkeley Symposium on Mathematical Statistics and Probability; Section on Mathematics; American Statistical Association; Biometric Society, WNAE; Institute of Mathematical Statistics; Section on Medical Sciences—9 A.M.; Statistics in Medicine and Public Health; 145 Dwinelle Hall

Physics

American Meteorological Society—9:15 A.M.; announcements and welcome; 312 LeConte Hall. 9:30 A.M.; Dynamic Meteorology; 312 LeConte Hall

American Physical Society—10 A.M.; concurrent session 1; invited papers: High Energy Physics; 310 LeConte Hall. 10 A.M.; concurrent session 2; contributed papers: Shock Waves; 4 LeConte Hall. 10 A.M.; concurrent session 3; contributed papers: Theoretical Physics; 3 LeConte Hall. 10 A.M.; concurrent session 4; contributed papers: High Energy Experimental Physics; 1 LeConte Hall

Chemistry

Section on Chemistry; American Chemical Society, California Section; Section on Medical Sciences—9 A.M.; symposium: Viruses; Auditorium, Chemistry Building

Astronomy

Astronomical Society of the Pacific; Section on Astronomy—9 A.M.; papers; 1 Leuschner Observatory

Meteoritical Society—9 A.M.; business meeting; 322 LeConte Hall. 9:30 A.M.; papers; 322 LeConte Hall

Geology and Geography

Division of Mines, State of California—8:30 A.M.; departure of geological field trip to the Central Coast Ranges; Parking Lot, Hotel Claremont

Section on Geology and Geography; Association of American Geographers, Pacific Division; Association of Pacific Coast Geographers—9 A.M.; contributed papers: General Geography; 290 Hearst Mining Building

Zoological Sciences

Society of Systematic Zoology; Pacific Coast Entomological Society—9 A.M.; contributed papers; 30 Wheeler Hall

Biological Sciences

American Society of Limnology and Oceanography—9 A.M.; contributed papers; 230 Forestry Building

Ecological Society of America and ESA, Western Section—9 A.M.; symposium: Dew as an Ecological Factor; 159 Forestry Building

Western Society of Naturalists; Section on Chemistry; Section on Zoological Sciences; Section on Botanical Sciences; American Society of Plant Physiologists, Western Section—9 A.M.; invited papers: Photochemical Effects in Biological and Biochemical Systems, II; 2003 Life Sciences Building

Western Society of Naturalists; Section on Zoological Sciences—9 A.M.; symposium: Natural Resources of the West; 2000 Life Sciences Building

Botanical Sciences

American Phytopathological Society, Pacific Division—9 A.M.; symposium: Crop Sequence and Plant Disease Control; 113 Hilgard Hall

Psychology

Section on Psychology—9 A.M.; symposium: How Can Behavior Theory Best Handle the Construct of Motivation? 123 Haviland Hall

Social and Economic Sciences

Society for the Advancement of Criminology—9 A.M.; Education in Criminology, I; 15 Dwinelle Hall

History and Philosophy of Science

Section on History and Philosophy of Science—9 A.M.; contributed papers; 23 Dwinelle Hall

Engineering

American Society for Engineering Education, Pacific Southwest Section—9 A.M.; registration; foyer, Gymnasium for Men. 10 A.M.; Trends in Engineering Education; 105 Engineering Building

Medical Sciences

Section on Medical Sciences—9 A.M.; symposium: Physiology of Growth—Normal and Abnormal, III; 101 California Hall

Bay Counties Veterinary Medical Association—10 A.M.; invited papers: Some Problems in the Care of Laboratory Animals; 11 Wheeler Hall. 11 A.M.; panel: Infectious Disease Control in a Small Animal Hospital; 11 Wheeler Hall

Society for Experimental Biology and Medicine, Southern California and Pacific Coast Sections—9 A.M.; contributed papers; 105 California Hall

Dentistry

Section on Dentistry; International Association for Dental Research, North American Division; American College of Dentists; American Dental Association—9 A.M.; symposium: Growth and Development; 100 Lewis Hall

Pharmacy

Section on Pharmacy; American Pharmaceutical Association, Scientific Section; American Association of Colleges of Pharmacy; American Society of Hospital Pharmacists; American College of Apothecaries—9 A.M.; contributed papers; Auditorium, Eshleman Hall. 10:30 A.M.; panel: Hazardous Domestic Pesticides and Household Chemicals; Auditorium, Eshleman Hall

Agriculture

Section on Agriculture—9 A.M.; symposium: Seed Production in the Western States; 125 Hilgard Hall

Education

National Association of Biology Teachers—8 A.M.; meeting of the executive board; 303 Wheeler Hall

National Association of Biology Teachers; American Nature Study Society—8:30 A.M.; Science Teaching Films; 311 Wheeler Hall. 9:30 A.M.; theme: Biology for Pleasure; 311 Wheeler Hall

Section on Education—9 A.M.; general papers; 103 Wheeler Hall

National Science Teachers Association—9 A.M.; general session: Science Teachers Face Their Problems; Auditorium, Wheeler Hall. 9:50 A.M.; concurrent session 1; Trends and Issues in Science Teachings: Kindergarten through Grade 6; 110 Wheeler Hall. 9:50 A.M.; concurrent session 2; Trends and Issues in Science Teaching: Grades 7 through 9; 200 Wheeler Hall. 9:50 A.M.; concurrent session 3; Trends and Issues in Science Teaching: Grades 10 through 12; 120 Wheeler Hall. 11 A.M.; concurrent session 1; symposium: My Best Teaching Unit: Elementary and Junior High School Science; 110 Wheeler Hall. 11 A.M.; concurrent session 2; My Best Teaching Unit: Senior High School Science; 200 Wheeler Hall. 11 A.M.; concurrent session 3; panel: The Science Teachers' Clinic; 120 Wheeler Hall

Science in General

American Nature Study Society—8 A.M.; meeting of the board of directors; 203 Wheeler Hall

Tuesday Noon and Afternoon, 28 Dec.

AAAS as a Whole

Academy Conference—1 P.M.; Ninth Annual Junior Scientists Assembly; Concert Hall, Creative Arts Building, San Francisco State College

International Conference on Animal Venoms IV—2 P.M.; 155 Dwinelle Hall

AAAS General Symposium—Science and Society, II; Population Problems; 4 P.M.; Auditorium, Wheeler Hall

Mathematics and Statistics

Institute of Mathematical Statistics; Third Berkeley Symposium on Mathematical Statistics and Probability—1:30 P.M.; invited addresses; 111 Dwinelle Hall

Institute of Mathematical Statistics—4 P.M.; contributed papers, I; 117 Dwinelle Hall

Physics

American Meteorological Society—1:30 P.M.; Optics, Radiation, and Instruments; 312 LeConte Hall. 4 P.M.; Demonstration of New Meteorological Instruments and Systems; Campanile Plaza

American Physical Society—2 P.M.; concurrent session 1; invited papers: Theoretical Physics; 1 LeConte Hall. 2 P.M.; concurrent session 2; invited and contributed papers: Nuclear Chemistry; 4 LeConte Hall. 2 P.M.; concurrent session 3; contributed papers: Electron Physics; 3 LeConte Hall. 2 P.M.; concurrent session 4; contributed papers: Nuclear Induction; 310 LeConte Hall

Chemistry

Section on Chemistry; American Chemical Society, California Section; Section on Medical Sciences—2 P.M.; symposium: Nucleic Acids and Nucleotides; Auditorium, Chemistry Building

Astronomy

Third Berkeley Symposium on Mathematical Statistics and Probability; Section on Mathematics; Section on Astronomy; American Statistical Association; Astro-

nomical Society of the Pacific; Institute of Mathematical Statistics—1:30 P.M.; *Statistics in Astronomy: The Spatial Distribution of Galaxies*; 145 Dwinelle Hall

Meteoritical Society—2 P.M.; papers; 322 LeConte Hall

Geology and Geography

Section on Geology and Geography; Association of American Geographers, Pacific Division; Association of Pacific Coast Geographers—1:30 P.M.; contributed papers: General Geography; 290 Hearst Mining Building

National Speleological Society; American Nature Study Society—2 P.M.; *The Underworld, the Last Frontier*; 2507 Life Sciences Building

Zoological Sciences

Herpetologists League—2 P.M.; scheduled papers; 3598 Life Sciences Building

International Union for the Study of Social Insects—2 P.M.; International Union announcements; 113 Hilgard Hall. 2:15 P.M.; symposium: Colony Organization and Related Processes in Social Insects; 113 Hilgard Hall

Society of Systematic Zoology—2 to 5 P.M.; open house; California Academy of Sciences

Biological Sciences

American Society of Limnology and Oceanography—2 P.M.; contributed papers; 230 Forestry Building

Ecological Society of America and ESA, Western Section—2 P.M.; contributed papers; 159 Forestry Building

Western Society of Naturalists—1:30 P.M.; contributed papers: Physiology; 2003 Life Sciences Building. 4 P.M.; business meeting; 2503 Life Sciences Building

Western Society of Naturalists; Arctic Institute of North America—1:30 P.M.; invited papers: Science in the Arctic, I; 2503 Life Sciences Building

Botanical Sciences

Mycological Society of America; American Phytopathological Society, Pacific Division; American Society of Plant Physiologists, Western Section; Botanical Society of America, Pacific Section; Society of American Bacteriologists, Northern California and Hawaiian and Southern California Branches; Section on Botanical Sciences—1:30 P.M.; symposium: Physicochemical Control of Structural Differentiation in the Fungi; 113 Agriculture Hall

Anthropology

Section on Anthropology—2 P.M.; contributed papers; 210 Haviland Hall

Psychology

Section on Psychology; Section on Engineering—2 P.M.; invited papers: Psychological Factors in Highway Safety; 113 Haviland Hall

Section on Psychology—2 P.M.; general papers; 123 Haviland Hall

Social and Economic Sciences

Section on Social and Economic Sciences; American Statistical Association; Western Economic Association; Pacific Coast Committee on Social Statistics of the Social Science Research Council—2 P.M.; symposium: Regional Economic Analysis; B45 Dwinelle Hall

Society for the Advancement of Criminology—2 P.M.; Education in Criminology, II; 15 Dwinelle Hall. 4 P.M.; business meeting; 15 Dwinelle Hall

History and Philosophy of Science

Section on History and Philosophy of Science—2 P.M.; contributed papers; 23 Dwinelle Hall

Engineering

American Society for Engineering Education, Pacific Southwest Section—12 noon; luncheon and annual business meeting; place to be announced. 3 P.M.; tea for ladies; place to be announced

Medical Sciences

Section on Medical Sciences—2 P.M.; symposium: Physiology of Growth—Normal and Abnormal, IV; 101 California Hall

Bay Counties Veterinary Medical Association—12 noon; luncheon and address; Berkeley Women's City Club. 2 P.M.; invited papers; 11 Wheeler Hall. 5 P.M.; social hour; Hotel Claremont

Society for Experimental Biology and Medicine, Southern California and Pacific Coast Sections—2 P.M.; symposium: Adrenal-Pituitary Relationships; 105 California Hall

Dentistry

Section on Dentistry; International Association for Dental Research, North American Division; American College of Dentists; American Dental Association—12:15 P.M.; luncheon; Men's Faculty Club. 1:30 P.M.; symposium: Radiation Hazards in the Dental Office; 100 Lewis Hall

Pharmacy

Section on Pharmacy; American Pharmaceutical Association, Scientific Section; American Association of Colleges of Pharmacy; American Society of Hospital Pharmacists; American College of Apothecaries—2 P.M.; contributed papers; Auditorium, Eshleman Hall. 3:30 P.M.; panel: Ways and Means of Improving Pharmacy Service; Auditorium, Eshleman Hall

Agriculture

Section on Agriculture—2 P.M.; symposium: Problems in Horticultural Crops; 125 Hilgard Hall

Education

National Association of Biology Teachers; American Nature Study Society—2 P.M.; theme: Biology for Living; 311 Wheeler Hall

Section on Education—2 P.M.; symposium: Problems Relating to Reading; 103 Wheeler Hall. 3:30 P.M.; vice-presidential address; 103 Wheeler Hall. 4:30 P.M.; business meeting; 103 Wheeler Hall

National Science Teachers Association—1:30 P.M.; general session: high-school student panel: Science, Science Classes, and Science Teachers; Auditorium, Wheeler Hall. 2:30 P.M.; concurrent session 1: Superior Students in Science; 30 Wheeler Hall. 2:30 P.M.; concurrent session 2: Outside Resources in Science Teaching; 110 Wheeler Hall. 2:30 P.M.; concurrent session 3: Teaching for Problem Solving; 120 Wheeler Hall

Science in General

National Association of Science Writers—4 P.M.; symposium: Science and National Security; 104 Engineering Building

Sigma Delta Epsilon—3 to 4:30 P.M.; tea and social hour for all women in science; University of California Women's Faculty Club

Tuesday Evening, 28 Dec.

AAAS as a Whole

AAAS Presidential Address—8 P.M.; Auditorium, Wheeler Hall

AAAS Reception—9 P.M.; Clubrooms, Stephens Memorial Union.

Zoological Sciences

Society of Systematic Zoology—6 P.M.; informal dinner; Fishermen's Wharf. 8 P.M.; Morrison Planetarium Show; California Academy of Sciences

Botanical Sciences

American Phytopathological Society, Pacific Division; Mycological Society of America—6:30 P.M.; Phytopathol-

ogists' banquet; Blue and Gold Room, Hotel Claremont
Social and Economic Sciences

Society for the Advancement of Criminology—7 P.M.; dinner, installation of officers, and social hour; place to be announced

Engineering

American Society for Engineering Education, Pacific Southwest Section—6:30 P.M.; annual dinner; place to be announced

Education

National Association of Biology Teachers—8 P.M.; meeting of the editorial board; 303 Wheeler Hall. 8 P.M.; meeting of the national membership committee; 306 Wheeler Hall

Wednesday Morning, 29 Dec.

AAAS as a Whole

Conference on Scientific Manpower—9 A.M.; II. Prospective Developments in the Utilization of Scientists and Engineers; 104 Engineering Building

International Conference on Animal Venoms, V—9 A.M.; 155 Dwinelle Hall

Conference on Scientific Editorial Problems—10 A.M.; I. Preparation of Technical Manuals for Complex Instruments; 125 Hilgard Hall

Mathematics and Statistics

Institute of Mathematical Statistics; Third Berkeley Symposium on Mathematical Statistics and Probability—9 A.M.; special invited papers; 145 Dwinelle Hall

Third Berkeley Symposium on Mathematical Statistics and Probability; Section on Mathematics; Section on History and Philosophy of Science; American Statistical Association; Institute of Mathematical Statistics; Philosophy of Science Association—10 A.M.; Probability and Induction; 145 Dwinelle Hall

Physics

American Meteorological Society; Society of American Foresters—9 A.M.; Fire Weather Problems and Objective Forecasting; 312 LeConte Hall

American Physical Society—9 A.M.; invited papers: High Energy Machines; 310 LeConte Hall

Chemistry

Section on Chemistry—9 A.M.; symposium: Chemistry in the Harnessing of Biological Resources, I; Auditorium, Chemistry Building

Astronomy

Astronomical Society of the Pacific; Section on Astronomy—9 A.M.; papers; 1 Leuschner Observatory

Meteoritical Society—9 A.M.; papers; 322 LeConte Hall

Geology and Geography

Section on Geology and Geography; Geological Society of America; American Geophysical Union—9 A.M.; symposium: Earth Sciences from the Air, I; 100 Lewis Hall

Zoological Sciences

Herpetologists League—9 A.M.; symposium: Problems in Ecology of Amphibians and Reptiles; 3598 Life Sciences Building

Society of Systematic Zoology—9 A.M.; annual business meeting; 30 Wheeler Hall. 10:20 A.M.; contributed papers; 30 Wheeler Hall

Biological Sciences

American Society of Limnology and Oceanography—9 A.M.; contributed papers; 230 Forestry Building. 11 A.M.; annual business meeting; 230 Forestry Building

Western Society of Naturalists; Section on Zoological Sciences; Section on Botanical Sciences; American Society of Plant Physiologists, Western Section; Society of

General Physiologists—9 A.M.; symposium: The Cell, I; 2000 Life Sciences Building

Botanical Sciences

American Phytopathological Society, Pacific Division; Mycological Society of America—9 A.M.; demonstration of Methods of Assay for Soil-Inhabiting Microorganisms; 113 Hilgard Hall. 10:30 A.M.; discussion on Soil Borne Virus Diseases of Plants; 113 Hilgard Hall

Anthropology

Section on Anthropology—10 A.M.; symposium: Culture Change in the Pacific Area, I; 113 Haviland Hall

Psychology

Section on Psychology—9 A.M.; general papers; 123 Haviland Hall

Social and Economic Sciences

Section on Social and Economic Sciences; American Statistical Association; Pacific Coast Committee on Social Statistics of the Social Science Research Council—9:30 A.M.; symposium: The Social Structure of Cities; B45 Dwinelle Hall

Engineering

American Society for Engineering Education, Pacific Southwest Section—9 A.M.; committee reports and panel: Industry's Stake in Engineering Education; 105 Engineering Building

Medical Sciences

American Academy of Forensic Sciences—9 A.M.; symposium: Medical-Legal Aspects of Head Injuries; 15 Dwinelle Hall

Pharmacy

Section on Pharmacy; American Pharmaceutical Association, Scientific Section; American Association of Colleges of Pharmacy; American Society of Hospital Pharmacists; American College of Apothecaries—9 A.M.; contributed papers; Auditorium, Eshleman Hall

Education

National Association of Biology Teachers—8 A.M.; meeting of the executive board; 303 Wheeler Hall

National Association of Biology Teachers; American Nature Study Society—8:30 A.M.; Science Teaching Films; 311 Wheeler Hall. 9:30 A.M.; theme: Biology for Survival; 311 Wheeler Hall

National Science Teachers Association; National Association for Research in Science Teaching; AAAS Cooperative Committee on the Teaching of Science and Mathematics; Section on Education; Western Society of Naturalists—9 A.M.; symposium: Research in Science Education; Auditorium, Wheeler Hall

Section on Education; International Council for Exceptional Children—9 A.M.; panel: Problems in the Development of Educational Programs for Exceptional Children; 103 Wheeler Hall

Wednesday Noon and Afternoon, 29 Dec.

AAAS as a Whole

Conference on Scientific Editorial Problems—2 P.M.; II. Effective Technical Writing; 125 Hilgard Hall

International Conference on Animal Venoms, VI—2 P.M.; 155 Dwinelle Hall

AAAS General Symposium—Science and Society, III: Science in Human Thought and Action; 4 P.M.; Auditorium, Wheeler Hall

Mathematics and Statistics

Institute of Mathematical Statistics; Third Berkeley Symposium on Mathematical Statistics and Probability—1:30 P.M.; Comparison of Experiments; 111 Dwinelle Hall

Institute of Mathematical Statistics—4:30 P.M.; contributed papers, II; 117 Dwinelle Hall

Physics

American Meteorological Society; Section on Geology and Geography—1:30 P.M.; symposium: Microclimatology; 312 LeConte Hall

American Physical Society—12:30 P.M.; open luncheon meeting; University Cafeteria. 2:30 P.M.; concurrent session 1; invited and contributed papers: Nuclear Polarization; 310 LeConte Hall. 2:30 P.M.; concurrent session 2; contributed papers: Experimental Meson Physics; 4 LeConte Hall. 2:30 P.M.; concurrent session 3; contributed papers: Solid State Physics; 1 LeConte Hall

Chemistry

Alpha Chi Sigma—12 noon; Alpha Chi Sigma luncheon; University Cafeteria

Section on Chemistry—2 P.M.; symposium: Chemistry in the Harnessing of Biological Resources, II; Auditorium, Chemistry Building

Pacific Southwest Association of Chemistry Teachers—2 P.M.; business session; 217 Chemistry Building

Astronomy

Third Berkeley Symposium on Mathematical Statistics and Probability; Section on Mathematics; Section on Astronomy; American Statistical Association; Astronomical Society of the Pacific; Institute of Mathematical Statistics—1:30 P.M.; Statistics in Astronomy: The Distribution of Stars in the Hertzsprung-Russell Diagram; 145, Dwinelle Hall

Meteoritical Society—2 P.M.; papers; 322 LeConte Hall. 2:30 P.M.; business meeting; 322 LeConte Hall. 3 P.M.; presidential address; 322 LeConte Hall. 3:30 P.M.; meeting of the 1954-58 council, 322 LeConte Hall

Geology and Geography

Section on Geology and Geography; Geological Society of America; American Geophysical Union—1:30 P.M.; symposium: Earth Sciences from the Air, II (including 3-D film); Auditorium, Wheeler Hall

Zoological Sciences

Cooper Ornithological Society; Section on Zoological Sciences—2 P.M.; papers; 159 Forestry Building

Herpetologists League—2 P.M.; unscheduled papers, discussion, business meeting; 3598 Life Sciences Building

Society of Systematic Zoology—2 P.M.; panel: Museums; Clubroom, Stephens Union. 4 P.M.; tea; Memorial Room, Stephens Union. 5 P.M.; film; 11 Wheeler Hall

Biological Sciences

American Society of Limnology and Oceanography—2 P.M.; contributed papers; 230 Forestry Building

Western Society of Naturalists—1:30 P.M.; contributed papers: Natural History; 2003 Life Sciences Building

Western Society of Naturalists; Section on Zoological Sciences; Section on Botanical Sciences; American Society of Plant Physiologists, Western Section; Society of General Physiologists—2 P.M.; symposium: The Cell, II; 2000 Life Sciences Building

Western Society of Naturalists; Arctic Institute of North America—1:30 P.M.; invited papers: Science in the Arctic, II; 2503 Life Sciences Building

Botanical Sciences

American Phytopathological Society, Pacific Division; Mycological Society of America—2 P.M.; symposium: The Mode of Survival of Plant Pathogens in the Soil; 113 Agriculture Hall

Section on Botanical Sciences—4:30 P.M.; open house for all botanists; 2023 Life Sciences Building

Anthropology

Section on Anthropology—2 P.M.; symposium: Culture Change in the Pacific Area, II; 123 Haviland Hall

Psychology

Section on Psychology—2 P.M.; invited papers: The Nervous System and Behavior; 113 Haviland Hall

Social and Economic Sciences

Section on Social and Economic Sciences; American Statistical Association; Pacific Coast Committee on Social Statistics of the Social Science Research Council—2 P.M.; symposium: Pacific Coast Population Trends; B45 Dwinelle Hall

History and Philosophy of Science

Section on History and Philosophy of Science—12 noon; Section L luncheon; place to be announced. 2 P.M.; contributed papers; 23 Dwinelle Hall. 4 P.M.; vice-presidential address; 23 Dwinelle Hall

Engineering

American Society for Engineering Education, Pacific Southwest Section—12:15 P.M.; luncheon; place to be announced. 1:45 P.M.; Education and Accreditation of Engineers; 105 Engineering Building

Pharmacy

Section on Pharmacy; American Pharmaceutical Association, Scientific Section; American Association of Colleges of Pharmacy; American Society of Hospital Pharmacists; American College of Apothecaries—2 P.M.; contributed papers; Auditorium, Eshleman Hall. 3:30 P.M.; panel: Administrative Responsibilities of the Hospital Pharmacist; Auditorium, Eshleman Hall

Education

National Association of Biology Teachers; American Nature Study Society—12:30 P.M.; NABT-ANSS luncheon and address; Hotel Durant

National Association of Biology Teachers—2:30 P.M.; theme: Our Biology Laboratory Problems; 30 Wheeler Hall. 4 P.M.; reports of recorders of group work; 30 Wheeler Hall

Section on Education; International Council for Exceptional Children—2 P.M.; Recent Research in the Education of Exceptional Children; 103 Wheeler Hall

National Science Teachers Association—12 noon to 2 P.M.; "Try-It-Yourself" Exhibits; 230 Wheeler Hall. 2 P.M.; general session: Progress in Science Education; 11 Wheeler Hall. 2:30 P.M.; concurrent session 1; Elementary Program A; 110 Wheeler Hall. 2:30 P.M.; concurrent session 2; Elementary Program B; 120 Wheeler Hall. 2:30 P.M.; concurrent session 3; Elementary Program C; 200 Wheeler Hall. 2:30 P.M.; concurrent session 4; High-School Biology; 210 Wheeler Hall. 2:30 P.M.; concurrent session 5; High-School Chemistry; 213 Wheeler Hall. 2:30 P.M.; concurrent session 6; High-School Physics; 122 Wheeler Hall. 4 to 6 P.M.; "Try-It-Yourself" Exhibits; 230 Wheeler Hall

Science in General

American Nature Study Society—2 P.M.; conference: ANSS—Should We Expand Our Activities? 311 Wheeler

Wednesday Evening, 29 Dec.

AAAS as a Whole

Society of the Sigma Xi—Annual Address; 8 P.M.; Auditorium, Wheeler Hall

Conference on Scientific Editorial Problems—III. 8 P.M.; Scientific Journals; 125 Hilgard Hall

Mathematics and Statistics

Institute of Mathematical Statistics—7:30 P.M.; business meeting; 117 Dwinelle Hall

Institute of Mathematical Statistics; Section on Mathematics—9 P.M.; beer party for all mathematicians and statisticians; Angelo's, Emeryville

Physics

American Meteorological Society—7 P.M.; dinner; Fishermen's Wharf, San Francisco

Chemistry

Pacific Southwest Association of Chemistry Teachers—6:30 P.M.; dinner; Grill Room, Men's Faculty Club

Astronomy

Section on Astronomy; Astronomical Society of the Pacific—5:45 P.M.; Astronomers' dinner; Women's Faculty Club. 8 P.M.; vice-presidential address of Section D; 145 Dwinelle Hall

Meteoritical Society—6 P.M.; Meteoritical Society dinner; Japanese Room, Yamato Sukiyaki House, San Francisco

Geology and Geography

Section on Geology and Geography; Association of American Geographers, Pacific Division; Association of Pacific Coast Geographers; Geological Society of America—8 P.M.; vice-presidential address and Section E smoker; Senior Men's Hall

Zoological Sciences

Herpetologists League—5:30 P.M.; Herpetologists' social; University Cafeteria. 6 P.M.; Herpetologists' dinner; University Cafeteria. 6:45 P.M.; address; University Cafeteria

Society of Systematic Zoology; American Society of Ichthyologists and Herpetologists—8 P.M.; lecture; 11, Wheeler Hall

Society of Systematic Zoology—9 P.M.; council meeting II; Council Room, Stephens Union

Biological Sciences

Western Society of Naturalists—6 P.M.; annual banquet and presidential address; University Cafeteria

Psychology

Section on Psychology—8 P.M.; vice-presidential address; 113 Haviland Hall

Pharmacy

Section on Pharmacy; American Pharmaceutical Association, Scientific Section; American Association of Colleges of Pharmacy; American Society of Hospital Pharmacists; American College of Apothecaries—7 P.M.; dinner meeting of the Northern California Society of Hospital Pharmacists; Hotel Claremont

Education

National Association of Biology Teachers—8 P.M.; meeting of editorial board; 303 Wheeler Hall

Science in General

American Nature Study Society—6 P.M.; ANSS banquet. 8 P.M.; ANSS presidential program. 9:30 P.M.; ANSS mixer. Places to be announced

Thursday Morning, 30 Dec.

AAAS as a Whole

AAAS council meeting II—9 A.M.; Auditorium, Eshleman Hall

International Conference on Animal Venoms, VII—9 A.M.; 155 Dwinelle Hall

AAAS Cooperative Committee on the Teaching of Science and Mathematics—10 A.M.; The Crisis in Science Education, I; Auditorium, Chemistry Building

Mathematics and Statistics

American Mathematical Society; Section on Mathematics; Third Berkeley Symposium on Mathematical Statistics and Probability—11 A.M.; contributed papers; 111 Dwinelle Hall

Third Berkeley Symposium on Mathematical Statistics and Probability; Section on Mathematics; American Statistical Association; Institute of Mathematical Statistics—9 A.M.; Mathematical Statistics; 145 Dwinelle Hall

Third Berkeley Symposium on Mathematical Statistics and Probability; Section on Mathematics; Section on Engineering; American Statistical Association; Institute of Mathematical Statistics—10 A.M.; Statistics in Industrial Research; 145 Dwinelle Hall

Physics

American Meteorological Society—9 A.M.; Pacific Meteorology; 312 LeConte Hall

American Physical Society—9 A.M.; concurrent session 1; invited papers: Nuclear and Electron Resonance; 310 LeConte Hall. 9 A.M.; concurrent session 2; invited and contributed papers: Theoretical Physics; 3 LeConte Hall. 9 A.M.; concurrent session 3; contributed papers: Low Energy Experimental Physics; 4 LeConte Hall. 9 A.M.; concurrent session 4; invited and contributed papers; High Energy Electron Physics; 1 LeConte Hall

Chemistry

Section on Chemistry—9 A.M.; contributed papers; 100 Lewis Hall

Astronomy

Section on Astronomy; Astronomical Society of the Pacific; Meteoritical Society—trip to Lick Observatory, Mount Hamilton

Geology and Geography

Section on Geology and Geography; Geological Society of America—9 A.M.; contributed papers: General Geology; 290 Hearst Mining Building

Zoological Sciences

Society of Systematic Zoology; Pacific Coast Entomological Society—9 A.M.; contributed papers; 30 Wheeler Hall

Biological Sciences

American Society of Limnology and Oceanography; Ecological Society of America and ESA Western Section—9 A.M.; symposium: Recent Advances in Biological Oceanography; 159 Forestry Building

Ecological Society of America and ESA, Western Section; Herpetologists League—9 A.M.; departure of field trip to Muir Woods and Stinson Beach State Park; West Gate of Campus

Western Society of Naturalists—9:15 A.M.; contributed papers: Marine Zoology; 2507 Life Sciences Building

Western Society of Naturalists; Arctic Institute of North America—9:15 A.M.; invited papers: Science in the Arctic, III; 4093 Life Sciences Building

Botanical Sciences

Section on Botanical Sciences—9 A.M.; contributed papers; 113 Agriculture Hall

Anthropology

Section on Anthropology—9 A.M.; symposium: The Contribution of India-Pakistan Studies to Social Science Theory; 113 Haviland Hall

Psychology

Section on Psychology—9 A.M.; general papers; 123 Haviland Hall

Engineering

Section on Engineering; Section on Chemistry; Section on Medical Sciences; Section on Agriculture; American Geophysical Union—9:30 A.M.; symposium: Air Pollution, I; 101 California Hall

Medical Sciences

Alpha Epsilon Delta; Sigma Pi Sigma; Section on Chemistry; Section on Zoological Sciences; Section on

Medical Sciences; Section on Dentistry—9 A.M.; symposium: Preparation for Medical and Dental Education in the Liberal Arts College; 11 Wheeler Hall

American Psychiatric Association; Section on Medical Sciences—9 A.M.; panels: Psychiatry-Pharmacology: Recent Advances: Clinical Applications of Chlorpromazine and of Reserpine; 105 California Hall

Donner Laboratory of Biophysics and Medical Physics; Section on Physics; Section on Medical Sciences—9 A.M.; Recent Advances in Biophysics and Medical Physics, I: Cellular Biophysics; 2000 Life Sciences Building

Pacific Slope Biochemical Conference—9 A.M.; concurrent session 1; papers: Biochemical and Biophysical Methods; 2003 Life Sciences Building. 9 A.M.; concurrent session 2; papers: Metabolism and Endoerines; 2503 Life Sciences Building

Industrial Science

Section on Industrial Science—9:30 A.M.; symposium: The Roles of Government, Industry, and the University in Basic Research, I; Salem Room, Hotel Claremont

Education

National Association of Biology Teachers; American Nature Study Society—9 A.M.; departure of field trip to Muir Woods and Stinson Beach State Park; lobby, Wheeler Hall

Science in General

Society of the Sigma Xi—10 A.M.; 55th annual convention; Emerald Room, Hotel Claremont

Thursday Noon and Afternoon, 30 Dec.

AAAS as a Whole

AAAS Section Officers' luncheon and business meeting—12 noon; Town Room, Hotel Shattuck

Conference on Scientific Editorial Problems—2 P.M.; IV. Military and Industrial Technical Reports; 100 Lewis Hall

International Conference on Animal Venoms, VIII—2 P.M.; 155 Dwinelle Hall

AAAS Cooperative Committee on the Teaching of Science and Mathematics—2 P.M.; The Crisis in Science Education, II; Auditorium, Chemistry Building

Pacific Science Board—4 P.M.; Public Lecture; Auditorium, Wheeler Hall

Mathematics and Statistics

American Statistical Association; Institute of Mathematical Statistics; Section on Mathematics—2 P.M.; panel: The Meaning of Probability to the Engineer, Mathematician, and Physicist; 111 Dwinelle Hall

Institute of Mathematical Statistics—4 P.M.; contributed papers, III; 117 Dwinelle Hall

Third Berkeley Symposium on Mathematical Statistics and Probability; Section on Mathematics; Section on Psychology; Section on Education; American Statistical Association; Institute of Mathematical Statistics; Western Psychological Association—1:30 P.M.; Statistics in Psychology; 145 Dwinelle Hall

Physics

American Meteorological Society—1:30 P.M.; Weather Modification; 312 LeConte Hall

American Physical Society—1:30 P.M.; concurrent session 1; invited papers: Division of Electron Physics; 310 LeConte Hall. 1:30 P.M.; concurrent session 2; contributed papers: High Energy Experimental Physics; 4 LeConte Hall. 1:30 P.M.; concurrent session 3; contributed papers: Spectroscopy; 1 LeConte Hall. 1:30 P.M.; concurrent session 4; invited and contributed papers: Instrumentation; 3 LeConte Hall. 1:30 P.M.; concurrent

session 5; post-deadline contributed papers: Unstable Heavy Particles, Machine-made; 2 LeConte Hall

Zoological Sciences

Society of Systematic Zoology—2 P.M.; lecture: Cenozoic Vertebrate Paleontology and Continental Stratigraphy of Australia; 290 Hearst Mining Building

Biological Sciences

American Society of Limnology and Oceanography—visit to River and Harbor Laboratory, College of Engineering, University of California

Beta Beta Beta—12:15 P.M.; luncheon and regional meeting of the Western Region of Beta Beta Beta; Social Hall, Trinity Methodist Church, Bancroft and Dana Streets. 2:15 P.M.; contributed papers; Social Hall, Trinity Methodist Church

Western Society of Naturalists—1:30 P.M.; contributed papers: Protozoology and Parasitology; 4093 Life Sciences Building

Western Society of Naturalists; Arctic Institute of North America; American Society of Limnology and Oceanography—1:30 P.M.; invited papers: Science in the Arctic, IV: Distribution of the Plankton of the North Pacific Ocean; 159 Forestry Building

Botanical Sciences

Section on Botanical Sciences; Botanical Society of America, Pacific Section; American Society of Plant Physiologists, Western Section; American Society of Naturalists—2 P.M.; symposium: Modern Views on Tissue Differentiation; 113 Agriculture Hall

Anthropology

Section on Anthropology—2 P.M.; contributed papers; 123 Haviland Hall

Psychology

Western Psychological Association; Section on Psychology—2 P.M.; symposium: Perception: Learned and Unlearned; 113 Haviland Hall

Social and Economic Sciences

Section on Social and Economic Sciences—2 P.M.; symposium: The Organization of Research for Western Regional Development; B45 Dwinelle Hall

Engineering

Section on Engineering; Section on Chemistry; Section on Medical Sciences; Section on Agriculture; American Geophysical Union—2 P.M.; symposium: Air Pollution, II; 101 California Hall

Medical Sciences

Alpha Epsilon Delta—12:15 P.M.; luncheon and address; Turquoise Room, University Cafeteria

Alpha Epsilon Delta; Sigma Pi Sigma; Section on Chemistry; Section on Zoological Sciences; Section on Medical Sciences; Section on Dentistry—2 P.M.; round-table discussions: Preparation for Medical and Dental Education in the Liberal Arts College; 110, 120, 200, 210, Wheeler Hall. 4:30 P.M.; summary session for reports from round-table groups; 11 Wheeler Hall

American Psychiatric Association; Section on Medical Sciences—2 P.M.; panel: Psychiatry-Pharmacology: Recent Advances: Mechanism of Drugs with Behavioral Effects; 105 California Hall

Donner Laboratory of Biophysics and Medical Physics; Section on Physics; Section on Medical Sciences—2 P.M.; symposium: Recent Advances in Biophysics and Medical Physics, II: Biophysics and Medical Physics; 2000 Life Sciences Building

Pacific Slope Biochemical Conference—2 P.M.; concurrent session 1; papers: Enzymes, Photosynthesis, Protein Synthesis; 2003 Life Sciences Building. 2 P.M.; con-

Current session 2; papers: Metabolism, Amino Acids, Nucleic Acids; 2503 Life Sciences Building

Industrial Science

Section on Industrial Science—12:15 P.M.; luncheon and vice-presidential address; Blue and Gold Room, Hotel Claremont. 2:30 P.M.; The Roles of Government, Industry, and the University in Basic Research, II; Salem Room, Hotel Claremont

Science in General

Society of the Sigma Xi; Scientific Research Society of America—1 P.M.; luncheon; Lido Deck, Hotel Claremont

Scientific Research Society of America—3 P.M.; annual convention; Emerald Room, Hotel Claremont

Thursday Evening, 30 Dec.

AAAS as a Whole

Scientific Research Society of America—8 P.M.; annual address and award of William Procter prize; Auditorium, Wheeler Hall

AAAS, Society of Systematic Zoology—8:30 to 11 P.M.; Biologists' smoker (Open to all registrants); Terrace, Hearst Gymnasium for Women

Mathematics and Statistics

Section on Mathematics; Institute of Mathematical Statistics; Third Berkeley Symposium on Mathematical Statistics and Probability—6:30 P.M.; dinner of Mathematicians and Statisticians; Hotel Shattuck

Institute of Mathematical Statistics—8:30 P.M.; council meeting; 117 Dwinelle Hall

Physics

American Physical Society; Section on Physics; Sigma Xi—7:30 P.M.; Physicists' dinner; Men's Faculty Club

Zoological Sciences

Society of Systematic Zoology; Section on Zoological Sciences—6:30 P.M.; Zoologists' dinner and vice-presidential address of Section F; University Cafeteria

Biological Sciences

Western Society of Naturalists; Arctic Institute of North America—7:45 P.M.; invited papers: Science in the Arctic, V: motion pictures; 155 Dwinelle Hall

Botanical Sciences

Section on Botanical Sciences; American Society of Plant Physiologists, Western Section; Botanical Society of America, Pacific Section; Mycological Society of America—6:30 P.M.; Botanists' dinner and vice-presidential address of Section G; University Cafeteria

Social and Economic Sciences

Section on Social and Economic Sciences; Section on Anthropology; Section on Psychology; Section on Education—6 P.M.; Social Sciences dinner meeting and vice-presidential address of Section K; International House

National Association of Biology Teachers—8 P.M.; meeting of the executive board; 303 Wheeler Hall

Friday Morning, 31 Dec.

Mathematics

American Mathematical Society; Section on Mathematics; Third Berkeley Symposium on Mathematical Statistics and Probability—11 A.M.; contributed papers; 111 Dwinelle Hall

Institute of Mathematical Statistics; Third Berkeley Symposium on Mathematical Statistics and Probability—9 A.M.; visit to Institute of Forest Genetics, Placerville

Education

National Association of Biology Teachers; American

Nature Study Society—9 A.M.; theme: Special Activities in Conservation Education in the Western States; 311 Wheeler Hall

Friday Afternoon, 31 Dec.

AAAS as a Whole

AAAS Pacific Division—12:15 P.M.; luncheon meeting of the executive committee; Directors Room, Men's Faculty Club

Science in General

American Nature Study Society—2 P.M.; start of trip to California Academy of Sciences; Lobby, Wheeler Hall

AAAS ANNUAL EXPOSITION OF SCIENCE AND INDUSTRY

The AAAS Annual Exposition of Science and Industry, which dates back to 1924 (still earlier with certain pioneer exhibitors), has long been an important and integral part of the Association's annual meeting. It provides an outstanding opportunity for those who use the tools and materials of science to meet those who produce and distribute the same. The 1954 edition of the Exposition, by special arrangement housed in the Gymnasium for Men of the University of California, is up to the same high standard of previous years.

The exhibits include the latest and best in scientific books, instruments, and materials; they are on a scale, and with a diversity, not usually possible at the meeting of an individual society or group of societies in a single field of science. In addition to this "core" of the Exposition, a variety of organizations have special exhibits, and there are technical exhibits by large firms representative of the basic industries of the nation. Prominent concerns in the chemical, pharmaceutical, and other industries are sharing with the attending scientists some of their impressive technological accomplishments. The Exposition should not be missed by anyone who attends this 121st meeting.

The Exposition is open to (i) all registrants attending the 121st meeting; (ii) adults who have applied for, and received, complimentary tickets of admission.

HOURS OF THE ANNUAL EXPOSITION OF SCIENCE AND INDUSTRY

Monday, 27 Dec.	2 P.M. to 6 P.M.
Tuesday, 28 Dec.	9 A.M. to 5 P.M.
Wednesday, 29 Dec.	10 A.M. to 5 P.M.
	and 7:30 P.M. to 10 P.M.
Thursday, 30 Dec.	9 A.M. to 3 P.M.

EXHIBITS IN THE ANNUAL EXPOSITION OF SCIENCE AND INDUSTRY

AAAS New Member Service—Science—The Scientific Monthly (Booth 13). Whether or not one is a member of the American Association for the Advancement of Science, every person attending this meeting is cordially invited to visit the AAAS booth for information concerning the Association and its activities. Beyond the satisfaction of strengthening its work for science, for scientists, and for society by one's membership, there are demonstrable personal advantages in joining the Association.

Since its founding, in 1848, the Association has admitted to membership not only professional scientists but also other men and women who have a general interest in science, who wish to keep informed of the progress of science, and who would like to support the high purposes of the one organization that represents all science. The New

Member Service will be pleased to accommodate those who wish to join the Association as of 1 Jan. Members can conveniently nominate others for membership.

Included in the annual dues of \$6.50 (for 1955), each member has a choice of a year of *Science*, the professional scientist's newsworthy, or *The Scientific Monthly* (or both for an additional \$3.50). Free sample copies of these two publications will be distributed, and all not familiar with both magazines should visit this booth where Symposium Volumes and AAAS membership insignia are also on display. Prospective advertisers may obtain sample copies of the magazines and rate cards.

American National Red Cross (Booths 33 and 34).

American Optical Company, Instrument Division (Booth 45). The American Optical Company, Instrument Division, will introduce its newest student microscopes, Model 73, designed to provide instructor and student with a compound microscope which combines simplicity of operation, allowing more time for actual subject matter and less time for lengthy instruction on instrumentation, and specially designed optics to provide clear images, mechanical movements that are all metal and will give long trouble-free life. See this latest development in low-cost student instruments at the American Optical Company booth. A new polarized light attachment for use with the AO Stereoscopic microscopes will be shown. The newest development in a microscope lamp for group student use will be exhibited. A new Hand Sugar Refractometer will be shown and demonstrated which has automatic temperature compensation and illumination built into one compact unit. The well-known AO Phase microscope will be demonstrated as well as latest developments in laboratory microscopes of binocular and monocular design. An Instrument Division representative of the American Optical Company will be present at all times to discuss instruments displayed or help you with problems associated with instrument application.

The American Tobacco Company, Inc. (Booths 77 and 78). The Research Laboratory of The American Tobacco Company will demonstrate a recording automatic cigarette-weighing balance which was developed by its Instrument Division. This balance utilizes a servo mechanism and has been recently improved by the incorporation of an automatic counter thereby completely eliminating the human factor in the determination of cigarette weights on a laboratory scale or as a control in commercial production. Original applications of well-known principles such as this result in closer control of quality in Lucky Strike, Pall Mall, and Herbert Tareyton cigarettes. The exhibit will also include samples of the four main types of tobacco used in the production of cigarettes. Technical literature will be available for distribution.

Animal Welfare Institute (Booth 74). The Schweitzer medal, honoring the great physician and humanitarian, Albert Schweitzer, will be displayed for the first time. The Animal Welfare Institute will award this medal, together with \$500, to the scientist who does most to further a major aim of the institute: To foster developments in experimentation whereby animal suffering may be minimized. Blanks for the use of persons who wish to nominate a scientist for this award will be available at the booth. Also on display, and available free on request, will be copies of *Basic Care of Experimental Animals*, a manual now in use in most medical and veterinary schools, as well as a large number of commercial laboratories, in the United States. Another new Animal Welfare Institute publication, *Comfortable Quarters for Laboratory Animals*, will also be on exhibit and available without charge.

It is a loose-leaf collection of floor plans, construction details, cages and other information prepared for institutions which contemplate improvements in their animal quarters through remodeling, re-equipping, or building. The material has been selected with a view to overcoming major problems in modern animal houses, such as overcrowding, lack of room for exercise, lack of comfortable resting places for animals, and inadequate ventilation and sanitation. New material will be continuously added and made available to interested institutions.

Annual Reviews, Inc. (Booth 61). Annual Reviews, Inc., is a nonprofit corporation which, since 1931, has been engaged in the publication of annual reviews in the various sciences. In each Review an attempt is made to survey, through the cooperation of 20 or more distinguished scientists, the progress which is being made, year by year. The reviews are critically written and the present status of the science carefully appraised. The particular sciences to which these Reviews pertain are as follows, year of inception and name of editor indicated in parentheses: Annual Review of *Biochemistry* (1932; J. M. Luck); Annual Review of *Physiology* (1939; V. E. Hall); Annual Review of *Microbiology* (1947; C. E. Clifton); Annual Review of *Medicine* (1950; W. C. Cutting); Annual Review of *Plant Physiology* (1950; D. I. Arnon); Annual Review of *Physical Chemistry* (1950; G. K. Rollefson); Annual Review of *Psychology* (1950; C. P. Stone); Annual Review of *Nuclear Science* (1952; J. G. Beckerley); Annual Review of *Entomology* (to appear in 1956; E. A. Steinhaus). Each of the eight Reviews published in 1954 will be on display, together with back volumes. All of these publications are sold at \$7 per copy, postpaid. Orders may be placed with the attendant in the exhibit booth or may be addressed to Annual Reviews, Inc., Stanford, California.

Applied Research Laboratories (Booth 53). The Applied Research Laboratories will exhibit the latest instruments for spectro-chemical analysis. Engineers in attendance will be glad to demonstrate and discuss optical emission spectrographs, quantometers, x-ray fluorescence equipment and power sources. Reprints of the latest techniques are available as well as full information on the quantometers, and the new curved crystal x-ray spectrometers. We welcome your visit to our booth.

Arctic Institute of North America (Booths 31 and 32).

Association of American University Presses (Booth 96). The university presses, leaders in the field of nonfiction, each year publish a large number of important titles. Many of these gain lasting recognition as reference books and college texts. Each press represented in the Association of American University Presses' exhibit at the 1954 AAAS Annual Exposition of Science and Industry is a separate publishing company producing technical, medical, and scholarly works as well as general books of vital interest to all Americans. This exhibit offers you an opportunity to see the new books from various university presses at our booth.

Atchison, Topeka and Santa Fe Railway Company (Booths 11 and 12). A Santa Fe model railroad with a purpose—constructed over a period of 4½ years by Bill Morgan, a railroad hobbyist, from San Diego, Calif. Its purpose is to provide education and amusement for children and adults alike. The model displays 5½ scale miles of track. It has 30 electrically operated switches and can handle three operating trains each at the same time, each one independent of the other. The entire roadbed has actual sanded ballast to conform to prototype. Automatic signals indicate location of all trains. Passenger trains

are complete with rivet detailed sides; working springs in all trucks, and finished interiors including overhead lights in all cars. The rails were laid with miniature railroad spikes requiring more than 10,000 spikes. Twenty-seven of its 30 switches were hand-made from 6-ft strips of brass rail; each has its own jeweled switch stand to indicate the position of the switch. The control board is a complete unit, carrying more than 100 wire cables. It is operated by 3 transformers, 5 rectifiers, 4 power stats, and 7 relays. The mobile railroad unit in the past has amused many shut-ins confined in hospitals and rest homes throughout Southern California.

Beckman Instruments, Inc. Berkeley Division (Booth 44). Berkeley Division of Beckman Instruments, Inc., is exhibiting instrumentation for the laboratory and clinical measurement of radioactivity. In particular, a complete system for medical use of radioisotopes for clinical diagnosis will be on display and sealing equipment and monitoring equipment with associated accessories for the radio assay of radioisotopes used in various branches of chemical research will be shown. Both of these systems in these two general fields will be displayed as operating systems.

Beckman & Whitley, Inc. (Booth 41). Beckman & Whitley, Inc., Instruments Division will display its line of meteorological instruments, including a new high Resolution Anemometer, Radiometer, and Heat Flow Transducers. The new Model 189 Framing Camera will be shown, and a demonstration will be given once each day—showing how pictures are taken at rates over 1 million per second! The demonstration schedule will be posted at the Beckman & Whitley Booth No. 41.

The Bioscope Manufacturing Company (Booth 28). The Bioscope Manufacturing Company will exhibit The Bioscope, an instrument that will project microscopic slides down on a table or on a wall screen and is especially made to project living material without harmful heat. The Bioscope makes microscopic study interesting to students; speeds up microscopic study tremendously; eliminates eye strain and cramped positions; makes a great saving in microscopes and slides; and is self-contained in a long-lasting case. Master Model Bioscope Complete is \$116; specially selected slides, 25 per set, \$8.50. Superintendents, principals, and science teachers are cordially invited to Booth 28 in the Exposition to see The Bioscope. Bioscope Manufacturing Co., Box 1492, Tulsa, Okla.

California Research Corporation (Booth 40). The exhibit of the California Research Corporation shows characteristics and samples of surface coatings and plastics derivatives of isophthalic acid which are illustrative of the following information:

Isophthalic alkyd resins containing 75 to 80 percent soybean oil are in excellent condition after nearly 5 years of outdoor weathering and are equal to conventional phthalic anhydride alkyd resins containing 65 percent soybean oil. An isophthalic alkyd type of house paint vehicle containing 90 percent soybean oil is also in good condition after nearly 5 years of outdoor weathering and is considerably better than conventional linseed oil house paint vehicles or a similar alkyd type of vehicle made from phthalic anhydride. Automotive, machinery, and appliance enamels are improved by the use of isophthalic alkyds. Tougher, more durable films are obtained. Isophthalic is an excellent material for use in unsaturated polyesters. Cured resins from isophthalic polyesters have considerably better flexural strength properties, and impact strengths are improved greatly when the isophthalic content of the polyester is high. Also, the heat distortion temperatures of cured resins made from isophthalic polyester are significantly higher than those of similar resins

made from phthalic anhydride. High polymer polyesters and polyamides containing isophthalic show interesting possibilities in films, fibers, and molding resins where modifications in melt point and crystallinity are desired. Plasticizers for polyvinyl chloride plastic products are more permanent, and the plastics retain flexibility longer when they are made from isophthalic.

Carolina Biological Supply Company (Booth 5). Carolina Biological Supply Company cordially invites you and your friends to visit us at Booth 5. Our exhibit will be of particular interest to botanists and plant pathologists as well as to zoologists. During the past year all phases of our botany department have been greatly improved under the capable guidance of Fred W. Emerson, who has been with us in the capacity of botany consultant. On display will be our new plant presses, vasculums, and kodachromes made up under his supervision. Also there will be shown our new and complete listing of instruments and tools, about which many of you have inquired in the past year. These items are now in stock and available for your immediate use. Plast-O-Mounts, biological specimens embedded in plastic for permanent preservation, will be exhibited along with our unbreakable plastic models. Our booth will be attended by professional biologists who will be glad to help you with your problems and invite your suggestions and criticism.

Central Scientific Company (Booths 67 and 68). Among many new items of apparatus for the physical, chemical, biological, and research laboratory which Cenco will exhibit in Booths 67-68 are a new Van de Graaff Generator which develops 200,000 to 300,000 volts for striking classroom demonstrations with electrostatic electricity; the new 1-gal capacity Waring Blender; Quikpure, a device for quickly changing tap water into the chemical equivalent of triple distilled water in terms of specific electric resistance; and five new science kits that have been designed to give pupils or students, ages 8 to 18, a better understanding of science and industry, and their importance in American living. The science kits are carefully prepared so the student can forecast weather; transmit and receive radio messages on the set he builds himself; learn the principles of light rays and study the stars through his own telescope; study rocks and minerals; and analyze the functions of the human body.

The Coca-Cola Company (Booths 36 and 37). Ice cold Coca-Cola will be served through the courtesy and co-operation of the Coca-Cola Bottling Company of Oakland and The Coca-Cola Company.

Denoyer-Geppert Company (Booth 6). The Denoyer-Geppert Company will exhibit its line of visual teaching aids to the biological sciences and related subjects, featuring the newly developed unbreakable Resiloplast anatomical models and many new charts imported from foreign countries. The new models can be dropped on a concrete floor without resultant damage, even to the painted surface because the plastic casting material permits use of paints that fuse directly with the cast, thereby making the surface an integral part of the model, not subject to chipping or flaking. Some of the plastic models also feature innovations of design, such as the new life-size dissectible torso and head model with interchangeable pelvic inserts for changing the sex of the model. The display will be a representative sampling of the wide variety of products available from Denoyer-Geppert Company. Virtually all aspects of biological science are "covered" by the many items in the D-G line, including botany, zoology, anatomy, physiology, embryology, histology, parasitology, neurology, and plant pathology. The exhibit will be of interest to anyone engaged in instructional activities in

the field of biology. Experienced representatives will be on hand to demonstrate our products, answer any questions, and discuss visual teaching aids problems.

Folkways Records & Service Corp. (Booth 39). The Folkways Records and Service Corp. of 117 W. 46 St., New York, N. Y. was established as a commercial company with one of its main purposes to document through phono-records and prerecorded tape the phenomena of sounds found on the earth, in sea and air. The Ethnic Folkways Library series provides recordings of the authentic music expression of peoples (and the cultural and social background in accompanying notes). The Science Series provides illustrations of sounds—animal, man-made and 'natural' both in and out of their specific environment (with accompanying notes by authorities in these fields). Folkways Records makes available records and tape recordings in literature, international folk music and jazz, and in the children's fields. Brochures will be distributed describing Folkways publications in detail and all products will be on display and demonstrated.

W. H. Freeman and Company (Booth 46). Textbooks in the biological sciences, chemistry, and geology will be exhibited by W. H. Freeman and Company, San Francisco. We invite you to drop in at Booth 46 and look over our publications: Hardin: *Biology: Its Human Implications*, ed. 2; DuShane and Regnery: *Experiments in General Biology*; Srb and Owen: *General Genetics*; Stern: *Principles of Human Genetics*; Bonner and Galston: *Principles of Plant Physiology*; Oosting: *The Study of Plant Communities*; Oginaky and Umbreit: *An Introduction to Bacterial Physiology*; Pauling: *College Chemistry and General Chemistry*, ed. 2; Malm and Frantz: *College Chemistry in the Laboratory and College Chemistry in the Laboratory No. 2*; Frantz: *A Laboratory Study of Chemical Principles*; Gilluly, Waters and Woodford: *Principles of Geology*; Krumbein and Sloss: *Stratigraphy and Sedimentation*; Levorsen: *Geology of Petroleum*; Newell et al.: *The Permian Reef Complex of the Guadalupe Mountains Region, Texas and New Mexico*; Niggli: *Rocks and Mineral Deposits*; Williams, Turner, and Gilbert: *Petrography*.

Adolf Frese Corporation (Booth 108). The Adolf Frese Corporation is the West Coast distributor for the new Emson Balance. This balance, of single-span design, is unmatched for speed, simplicity, reproducibility, accuracy, and dependability. It is a direct-reading balance, 200-g capacity, beam loaded, with an air-damping device that eliminates the disturbing effect of a magnetic field within the balance. The weight recording scale is in the center at eye level, and the weights are located in the base of the balance. Excessive vibrations associated with overhead weight type balances are avoided. The Emson Balance will be exhibited at the Adolf Frese Corporation booth.

The Graf-Apsco Company (Booth 52). The answer to any microscope repair problem will be found at Booth 52 of the Graf-Apsco Company "America's Leading Microscope Repair House." Guaranteed rebuilt microscopes of various brands are displayed as well as numerous hard-to-get or discontinued optics. The new Graf-Apsco microscopes with built-in safety features can be seen and compared. Latest Zeiss instruments of West Germany and information on Zeiss equipment can also be obtained.

Laboratory Equipment Company (Booth 66). The Laboratory Equipment Company of San Francisco will exhibit the following pieces of equipment: Hotpack Laboratory Ovens, Furnaces, Incubators and Water Baths; Metalab Steel Laboratory Furniture; Sartorius Selecta Analytical Speed Balances; Photovolt pH Meters; Aetna Water Still and Autoclaves; Leitz Microscopes; Reich-

ert Microtomes; Chemical Rubber Company Automatic Laboratory Glassware Washer; Stocker & Yale Laboratory Lamps; Beck Spectroscopes; Clay-Adams Centrifuges; Ohaus Scales; Royal Metal Laboratory Stools; Hellige Photoelectric Colorimeters; and other laboratory apparatus items and scientific instruments. In attendance: J. Karl Kolhede and A. O. Schlichtmann.

E. Leitz, Inc. (Booth 42). E. Leitz will exhibit microscopes, a new Micro Manipulator, and scientific opticals in general. Visitors are cordially invited to visit the Leitz booth for demonstrations and further information.

McGraw-Hill Book Company, Inc., and Blakiston Medical Division (Booths 91 and 92). The merger of the Blakiston Company with McGraw-Hill, which took place 1 Nov., makes the McGraw-Hill exhibit of unusual interest this year. The Blakiston imprint will continue to signify the high quality of publications in the health sciences for which the firm has been noted for generations, while the college texts and nonmedical reference works will be transferred to the McGraw-Hill list. Books on display include a broad selection of new and standard works in botany, biology, zoology, agriculture, chemistry, mathematics, physics, and every branch of engineering and the social sciences. The Blakiston Division books include several new and authoritative works in medicine, public health, pharmacy, and nursing. In attendance at the McGraw-Hill booths will be Harry P. Graves, vice president in charge of Pacific Coast office and field representatives Alden C. Paine, Robert Belanger, and Geoffrey Clouse.

Microchemical Specialties Co. (Booth 58).

Micro-Technical Services Co. (Booth 59).

Microtime Laboratories (Booths 85 and 86). Microtime Laboratories will present its latest model High Speed Flash X-ray Pulse Generators. This equipment produces extremely short duration (less than 2×10^{-7} sec) burst of x-rays in the 35kv-100kv range. In conjunction with the x-ray equipment we are also exhibiting the new MX-100 x-ray tube. This tube represents a new development in the field of commercially available field emission tubes. It has the advantage of a beryllium window, a conical anode for focusing the x-ray beam and gives longer tube life when used with this type of circuitry. This is the first time the new Kerr Electro-optical equipment has been shown. A cell with complete associated circuitry and camera will be exhibited. Associated equipment, that is, 100-kv Power Supply and Pulse transformer will also be shown.

National Geographic Society (Booths 21 and 22). The exhibit of the National Geographic Society will feature the *National Geographic Magazine* and the *Geographic School Bulletins*. Also on display will be maps, books, pictures, and other special educational materials of the society. An automatic projector will screen a continuous selection of natural color slides. The slides cover National Geographic field assignments and expeditions and were selected from illustrations by staff photographers of the *National Geographic Magazine*.

National Society for Medical Research (Booth 101).

North American Aviation, Inc. (Booths 14 and 15). North American Aviation will display a nuclear research reactor model as an example of the reactors the company has designed for medical, industrial, and scientific applications. The model will demonstrate how a full-scale reactor can be used for cancer therapy and other medical applications; the production of radioisotopes; and the development of radiation processing for food and drug preservation. Representatives from the company's Atomic Energy Department will be present to explain other types of reactors designed by North American for a wide variety

of applications in the field of nuclear research. The representatives will have available for distribution copies of the company's brochure, Nuclear Reactors for Science and Industry, the world's first catalog describing reactors available to qualified industrial, educational, and medical organizations. North American is one of the country's largest organizations developing the nonmilitary uses of atomic energy and is participating in the Atomic Energy Commission's program to develop economical electric power from nuclear energy.

Nuclear Instrument and Chemical Corporation (Booth 3). The exhibit of the Nuclear Instrument and Chemical Corporation will include: New Model D-47 Flow Counter with exclusive removable 120- μ g micromil window; a completely automatic Sample Changing system for use with GM, scintillation, proportional, or flow counting; the New Mediac medical uptake instrument designed specifically for quick and precise uptake measurements; a new Counting Rate Meter of high accuracy; a portable Survey Meter for measuring both fast and slow neutrons; and a completely re-engineered alpha, beta, gamma portable survey instrument, plus the Actigraph laboratory group for paper chromatography and absorption studies.

Office of Naval Research (Booth 10).

The Pacific Telephone and Telegraph Company (Booth 35). The Pacific Telephone and Telegraph Company will exhibit one or more late developments of the Bell Telephone Laboratories related to communications.

Philosophical Library (Booth 73). The Philosophical Library of New York will display some of their new titles in the field of General Sciences: *Development of the Guided Missile* by Kenneth W. Gatland; *Glass Reinforced Plastics* edited by Phillip Morgan; *The Gyroscope Applied* by K. I. T. Richardson; *Aspects of Deep Sea Biology* by N. B. Marshall; *The Elements of Chromatography* by T. I. Williams; *The Treasury of Philosophy* by Dagobert D. Runes.

Research Equipment Corporation (Booth 4). Chromatographic equipment for paper and column chromatography and apparatus for paper electrophoresis will be displayed by Research Equipment Corporation who specialize in the manufacture of this type of equipment. Included in the display will be the most recent model chromatography oven, chromatographic chambers for two-dimensional separation, and other miscellaneous equipment recently developed for paper chromatography. An assortment of pyrex chromatographic columns for column chromatography with some specially designed glass apparatus for use in this field will be shown. Also included in the display will be the new Reco Fraction Collector, and the new Sample Applicator for applying samples to chromatograms. The new Reco Vertical Curtain Electrophoresis will be shown and a comprehensive bibliography on paper electrophoresis will be available without charge. A very comprehensive bibliography of chromatography in general covering the last 10 years, cross-indexed by title, author, and subject matter, will be offered for a nominal charge.

Rinehart & Company, Incorporated (Booth 97). The exhibit from Rinehart & Company, Inc., will be composed of our publications for colleges and universities in the following academic disciplines: agriculture, anthropology, the biological sciences, chemistry, economics, education, mathematics, physics, psychology, sociology and zoology. Our display of more than 100 books will contain some recently published titles, which will warrant careful examination, not only for their content, but also for their physical beauty. Entomologists will be especially interested in examining the new *Introduction to the Study of*

Insects by Borror and DeLong; physicists will want to see Dirk ter Haar's *Elements of Statistical Mechanics* and Semat's *Introduction to Atomic Nuclear Physics*; mathematicians will be interested in Beaumont and Ball's *Introduction to Modern Algebra and Matrix Theory*; and psychologists and sociologists will be pleased to find a new work by Allen L. Edwards, entitled: *Statistical Methods for the Behavioral Sciences*. Psychiatrists and psychologists will find a display of the books published by Basic Books, Inc., which are distributed by Rinehart & Company. In addition to the texts for colleges and universities, Rinehart will display outstanding technical publications in radio, television, electronics, and electricity.

Henry Salvatori Laboratory of Geophysics, Stanford University (Booth 51). The major display of the Henry Salvatori Laboratory of Geophysics Exhibit is a Gravity Meter in an illuminated transparent lucite case. This extremely delicate mechanism is essentially a sensitive weighing scale. It has a sensitivity of 1/100 milligal which corresponds to a change of 1 part in 100 million of the total value of gravity. In terms of weight this is analogous to weighing small fractions of a pencil dot. Field experience has demonstrated that this sensitivity is sufficient to measure the very minute variations of the gravitational field caused by the normal changes of density found within the surface layers of the earth. Exploration geophysicists study these variations and are able to infer from these the distribution of subsurface masses. A seismogram profile and the corresponding dip-depth section, illustrating pertinent evidence of a specific subsurface structure, are also featured. This information is obtained by the reflection seismograph, the most successful and commonly used oil exploration method. Other displays are charts and schematic diagrams depicting geophysical information. This exhibit is made possible by the kind sponsorship of Western Geophysical Company of America of Los Angeles. Stanford University students of geophysics, who serve as attendants, participated in the preparation of the exhibit.

The Science Library (Booths 110, 111, 112). The Science Library is administered by the AAAS as an additional service to publishers of books, both exhibitors and nonexhibitors. It has become an integral part of each year's Annual Exposition of Science and Industry. In the Science Library, books of all publishers participating are grouped by fields of science—a convenience both to the visitor who is restricting his inspection of books to a single category and to the one who wishes to browse.

Among the publishers in the Science Library are American Association for the Advancement of Science, Academic Press Inc., Addison-Wesley Publishing Company, Inc., Annual Reviews, Inc., Appleton-Century-Crofts, Inc., Cambridge University Press, Chemical Publishing Co., Inc., Columbia University Press, Cranbrook Institute of Science, Thomas Y. Crowell Company, Crown Publishers, Inc., The Devin-Adair Company, E. P. Dutton & Co., Inc., Emerson Books, Inc., Folkways Records and Service Corp., W. H. Freeman and Company, Harvard University Press, D. C. Heath and Company, Paul B. Hoeber, Inc., Henry Holt and Company, Inc., Houghton Mifflin Company, Iowa State College Press, The Johns Hopkins Press, Lea & Febiger, J. B. Lippincott Company, Little, Brown & Company, The Macmillan Company, Josiah Macy, Jr. Foundation, Pantheon Books, Inc., Prentice-Hall, Inc., The Ronald Press Company, W. B. Saunders Company, Charles C. Thomas, Publisher, University of California Press, University of Minnesota Press, John Wiley & Sons, Inc., Yale University Press, The Year Book Publishers, Inc.

Scientific Film Company (Booth 48). Picture Yourself, the theme of the exhibit presented by the Scientific Film Company, points the way to better, more effective teaching, public relations, advertising, and sales promotion programs through the use of motion pictures. The Scientific Film Company, specialists in the production of fine motion pictures in the field of science, serves scientific societies, industrial organizations, colleges and universities, and public relations groups throughout the nation, helping them to bring themselves and their activities before the public. Business and industrial organizations have found that there is no better medium for publicizing their products or services than the use of motion pictures, either for direct audience viewing or for television. Teaching institutions find greater effectiveness with special film productions created specifically for their individual teaching programs; and they find that their public relations activities get better results with motion pictures. The Scientific Film Company gives special attention to limited budget productions; and now SFC brings the use of full color sound motion pictures within the means of every organization interested in education, public relations, or advertising. This is the age of motion pictures; and Scientific Film Company motion picture technologists would like to show you how you can *Picture Yourself*.

Silge & Kuhne (Booths 70 and 71). Microscopists, photomicrographers, and those interested in other branches of scientific photography will find the Silge & Kuhne exhibit of special interest. Shown in operation are the patented Ortho-Illuminators, including the new Ortho-Illuminator B—Modern apparatuses that embody an entirely new concept of illumination for the microscope. They are designed to be applied to, and combined with, any standard microscope, affording all of the advantages of "built-in illumination." Based on the Koehler principle, Ortho-Illuminators become, optically, an integral part of, and are in permanent alignment with, the microscope. They provide complete control of illumination as to intensity, color temperature, color, numerical aperture and field of view; thus, fulfilling the prerequisites for maximum microscope performance. They are instantly adaptable to brightfield, phase-contrast, darkfield, polarized light, fluorescent light work, in visual microscopy, photomicrography, or microprojection. The Orthophot camera assembly, which is also shown in operation embodies a novel concept of modern engineering principles applied to the field of scientific photography. One single unitized apparatus serves in a simple efficient way most branches of scientific photography, that is, photomicrography, photomacrography, laboratory and clinical photography, cine-photomicrography and technical photocopying, plus adaptation for enlarging and microprojection—all in a compact apparatus that can be kept on the laboratory desk or bench. The Orthophot provides excellent results in black and white or natural color in any of the mentioned fields, without special training. Be sure to see these interesting demonstrations.

Specialized Instruments Corporation (Booth 102). The Specialized Instruments Corporation will exhibit some of its new products: Spineco Model R. Paper Electrophoresis System, a new integrated group of instruments which coordinates and routinizes all paper electrophoresis operations, from precision specimen application to automatic computation and recording of component relationships; New Developments in Ultracentrifugation, special rotors and accessories developed to broaden the applicability of both analytical and preparative ultracentrifugation. Regular products include the Spineco Model E Analytical Ultracentrifuge; Spineco Model L Preparative Ultracentri-

fuge; and the Spineco Model H Electrophoresis-Diffusion Instrument.

Special Libraries Association, San Francisco Chapter (Booth 113). The San Francisco Chapter of the Special Libraries Association will exhibit materials to show what a special library is, what it does, and how it can assist scientists.

E. R. Squibb & Sons, Division of Olin Mathieson Chemical Corporation (Booths 53 and 56). Plant infections caused by bacteria are yielding to antibiotic treatment, as have human infections. A comprehensive display by John Powell & Company, a division of Olin Mathieson Chemical Corporation, tells the story with charts and photographs. On this occasion Powell introduces *Phytomycin*, a new streptomycin product, for use in the control of certain bacterial diseases of plants. This antibiotic, developed and produced in the laboratories of the Squibb Division, has been found to control fireblight of apple and pear trees. With the special problems of the orchardist in mind, the producer offers an aqueous solution of streptomycin nitrate. The liquid formulation is easy to measure. It is chemically compatible with many pesticides and therefore may offer possibilities of combination treatment.

J. W. Stacey, Inc. (Booths 1 and 2). Stacey's, established over a quarter of a century ago, provides those in the West with an efficient source for technical books of all publishers. At Booths 1 and 2 you will find displayed the latest in scientific literature.

Stanford Research Institute (Booths 8 and 9).

Teaching Aids Exchange (Booth 54). Teaching Aids Exchange will feature the Crow Electri-Kits. These kits provide a practical new visual-experiment method for teaching electricity and electronics at a cost within reach of every school. The exhibit will include the small kit designed for junior-high-school courses in general science and industrial arts electricity. It will also include the instructor demonstration kits which provide a complete laboratory for instruction in electricity and the fundamentals of electronic components. Also featured will be the rotating electric machine which is designed to give complete instruction on all types of a-c and d-c motors. Each kit contains complete apparatus for performing a related series of fascinating experiments that demonstrate visually electrical principles and their practical application. A coordinated text-manual fully describes and illustrates every experiment. The use of these kits relieves the instructor of tedious time-consuming preparation. It enables students with no mathematical background to grasp the principles of electricity readily. They learn by watching and doing the experiments.

Technical Equipment Co. (Booth 72). The Technical Equipment Company will demonstrate their line of precision electronic temperature controllers; their line of micro-rotameters; and their Automatic Orsat Gas Analyzer. They will also display photographs of their complete line of petroleum testing apparatus. Temperature controllers will be displayed which have a control accuracy of $\pm 0.001^\circ\text{C}$, ranges of -100°C to 500°C , and a resistance thermometer—precision bridge circuit design. These controllers will be demonstrated controlling a constant temperature bath to $\pm 0.001^\circ\text{C}$. The controllers are suitable for control of constant temperature baths for Warburg apparatus, viscometers, pycnometers, refractometers, PVT apparatus, as well as incubators, furnaces, and industrial temperature control. The micro-rotameters will be demonstrated on a test panel arranged for visitor participation. One rotameter tube with two floats (one hollow plastic; one solid platinum) will illustrate a range

of flow rates of air from 1 to 1200 ml/min. Rotameter holders from brass to the Hastelloys and floats from Teflon to platinum will be displayed. The Automatic Orsat Gas Analyzer demonstration will illustrate the use of an electronic control system to replace the manual recirculation of gases through Orsat absorbers. New equipment will be solicited from inventors for manufacture under license.

Technical Instrument Co. (Booth 47). Precision optical equipment is the main activity of the Technical Instrument Co. On exhibit will be a number of makes of microscopes, centrifuges, microtomes, and other special equipment, both imported and domestic. Information with respect to unconditionally guaranteed service and repair on any microscope is available for the asking. Imported telescopes, together with other scientific instruments, will be exhibited. Information on facilities for building special instruments to customers' designs will be available.

Tide Water Associated Oil Company (Booth 7). Controls and accessories have been added to a laboratory distillation column to provide automatic recording of data, control of reflux ratio, control of heat input, and separation of distillate samples. The principal novelty is the automatic control of reflux ratio. The design displayed is applicable directly to laboratory columns whose reflux ratio is set by an intermittent take-off device. The automation is obtained by making the intermittent take-off device skip one or more successive take-offs whenever a rise occurs in the temperature of the column top. It is thought that the device may be of interest to chemists in the petroleum and chemical industries.

Trans-Pacific Import and Export Co. (Booth 75). Olympus Microscopes are manufactured by the Olympus Optical Company of Japan, which is one of the oldest and largest manufacturers of optical instruments in Japan and is well known as the pioneer of the microscope industry in that country. With about 40 years of experience and much valuable assistance given them during that time by German precision instrument engineers and other readily available information, they are in a position today to build the finest of microscopes. In 1949 the Microscope Export Promotion Commission of Japan publicly stated that Olympus biological microscopes were the best obtainable in Japan. On 15 Oct. 1949, an official letter of commendation and highest award for their microscopes was granted to the Olympus people from the Minister of International Trade and Industry of the Japanese government. The name *Olympus* is a guarantee of the finest quality microscopes, and all Olympus Microscopes carry a 3-year guarantee against defective parts or workmanship. Please see our display of Olympus Microscopes in Booth 75 at the Gymnasium for Men.

University Apparatus Company (Booth 98). One of the outstanding exhibits to be presented at the 1954 Annual Exposition of Science and Industry will be that of the University Apparatus Co., of Berkeley, Calif. This 52-year old firm, as distributors of chromatography equipment and electrophoresis apparatus, will feature RSCo products manufactured by Research Specialties Co., of the same city. Paper electrophoresis units designed for both research and clinical uses will be exhibited. Accessory items will include power supplies and paper-strip scanners. The chromatography display will present new types of glass-jar and glass-tube units (Pyrex Glass), as well as a complete line of standard glass-jar (Pyrex Glass) and cabinet units, and the nonbreakable solvent trough assemblies which are an RSCo specialty. An im-

portant accessory will be a new electro-desalter unit. Instruments for other laboratory purposes will include a radioactivity sample holder, a constant temperature paraffin dispenser, and an all-stainless automatic pipette washer. Further, the University Apparatus Co., as sole distributors of Pyrex Laboratory Glassware in the convention city of Berkeley, California, expect to exhibit several new items in behalf of the Corning Glass Works, outstanding manufacturers of laboratory glassware.

University of California Schools of Medicine, San Francisco and Los Angeles (Booths 87 and 88). The exhibit of the Schools of Medicine of the University of California at Berkeley and Los Angeles is made possible by the kind sponsorship of the Cutter Laboratories of Berkeley, California.

W. M. Welch Manufacturing Company (Booths 49 and 50). The W. M. Welch Manufacturing Company will exhibit laboratory instruments for physics, chemistry, and biology departments including stainless steel balances, high vacuum pumps, electric measuring instruments, electronics teaching devices, an oscilloscope for recording peripheral arterial blood pressure, a densichron for measuring optical density and reflecting power, etc. Several new pieces will be shown for the first time:—a Maxwell top, film loops, for teaching repetitive processes, a new diffusion cloud chamber, a logarithm and trigonometric tables chart, a Van de Graaff generator, demonstration radio equipment, etc. Charts and sets of charts will be shown for teaching physics, chemistry, and biology.

Western Scientific Apparatus (Booth 69). Exhibit features special glass apparatus designed and built by Western, such as its mercury diffusion pump, micro-kjeldahl distillation apparatus, tilting McLeod gages, volatile acid still, and vacuum stirring apparatus. All this equipment will be in operation, as will the line of glassblowing equipment manufactured by Western. This includes crossfires, roller stands, annealing burners, ribbon burners, and a polariscope for the detection of strains in blown glassware. Literature describing both the specialties and the more common apparatus fabricated by Western will be available, and at least one of the firm's glassblowers will be on hand at all times to discuss and demonstrate the equipment. In addition to items of its own manufacture, Western will exhibit the Victor rotameter, a new flow measuring instrument, the Heller electronic timer for accurate short interval timing, and a line of standard taper joint thermometers, including an enclosed porcelain scale model. Of additional interest to the attendance will be a small glassblowing lathe with a glassblower actually fabricating apparatus.

Wyeth Laboratories (Booth 60). Improvements, over a 7-year period, in the formulation of venom inocula for hyperimmunization, in which certain venoms were deleted, others increased, and new venoms added to succeeding immunizing cycles resulted in the composition of a formula incorporating four venoms appearing to contain the basic antigens for all crotaline venoms; and led to production of a serum effective for all species of the family Crotalidae. Using a modification of the salting-out procedure, employed for production of antitoxins, a method of refinement has been developed with which a practically water-clear, concentrated antivenin has been obtained. Considerable investigation utilizing various test animals and venom-antivenom neutralization techniques, and using venoms from most crotaline species, has shown that neutralization of the venoms of the dominant species indicates adequate levels of antivenom for the minor species Crotalidae.

Polarization Patterns in Submarine Illumination

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ALTHOUGH the polarization of sky light has been known since 1809 and widely studied (1, 2), the comparable phenomenon in natural waters has scarcely been considered. The possible importance of this unexplored field has recently been emphasized by the discovery that polarized light has significant behavioral and physiological effects on a variety of arthropods. First demonstrated by von Frisch (3) in the honeybee, striking sensitivity to polarized light has since been found in a variety of insects and their larvae, crustaceans, and chelicerates.

Not only have these animals been shown capable of detecting polarized light, but also some of them have been found to use the natural polarization of the blue sky in navigating from one place to another. These facts have opened up a whole new field of visual physiology and behavior (4).

Among aquatic animals also polarized light sensitivity has proved to be widespread in the arthropods. The compound eye of *Limulus* was discovered to be sensitive to plane-of-light polarization, although so far the behavioral or ecological significance of such ability in this animal is unknown (5).

Behavioral reactions to polarized light have, however, been found by Baylor and Smith (6) in a number of fresh-water aquatic forms. Most interesting was their discovery that the swimming of eladoceran crustaceans like *Daphnia* could be predictably oriented by vertically or horizontally directed beams of plane-polarized light. Swimming was predominantly at right angles to the direction of the e vector in a vertically incident beam and could be repeatedly changed when the polarization plane was rotated. In a horizontal beam of polarized light, the crustacean's swimming direction was similarly related to the plane of polarization, being upward in a horizontally polarized beam and lateral, with the animals swimming on their sides, in vertically polarized illumination.

That polarized light of natural origin can have similar orienting effects on populations of these crustaceans was also demonstrated by these same workers, who briefly reported appropriate orientation of Cladocera exposed to the polarized light of the blue sky at sunset or sunrise. Homing on polarized shafts of penetrating light around shadows was predicted, too. The present data, however, indicate the importance for underwater polarization of the directionality of day-light illumination everywhere in the water. This presumably applies not only to the sea, where these obser-

vations were made, but also to any other extensive body of water, fresh or salt.

In view of these facts, then, the occurrence and pattern of light polarization in aquatic environments becomes a subject of wide potential relevance to various problems in oceanography and limnology. The basic principles of light polarization by scattering in gases and liquids have been well known since the pioneer work of Tyndall and Lord Rayleigh. Brief mention of the occurrence of polarized light in natural waters has been made (7-10), yet few if any, actual data are available.

The present observations on submarine illumination were, therefore, undertaken to outline the major characteristics of its polarization. The results indicate that to an even greater degree than terrestrial animals, aquatic forms of the photic zone are surrounded by a complex pattern of polarized light. For those that have eyes sensitive to it, this pattern may provide significant cues for orientation and migration.

The observations made so far have been carried out visually by the author, skin diving in the sea around Bermuda. Most of the data were taken in the surface 5 to 6 m, but a few measurements were made down to 15 m. Stations investigated included shallow turbid water in Ferry Reach, deeper more transparent areas in Castle Roads and the North Shore of St. George's Island, very clear oceanic water beyond the 2000-m contour of the South Shore, and cave waters of Harrington Sound. A face plate was employed for clear vision, and a special hand-held polarization analyzer was employed in examining the light from all directions. This device indicates by inspection the presence and plane of polarized light and at the same time allows an estimate of the degree of its polarization.

The polarized light detector utilized makes use of an interference pattern well known to crystallographers. The light being examined first passes in a convergent beam through a suitably thick plate of a uniaxial crystal cut perpendicularly to its axis. The light emerging from this is then circularly analyzed through a quarter wave plate and a disk of Polaroid film. The whole optic sandwich is cemented together and protected with glass covers.

If unpolarized light is viewed through this instrument, nothing is observed except a decrease in light intensity. If, however, plane-polarized white light is examined, a brightly colored interference pattern consisting of concentric, broken rings appears at the far

point of vision. This figure subtends a visual angle of about 15° in the unit used. In partially polarized light, the intensity of this pattern and the number of concentric rings observable vary with the percentage polarization. Thus with strongly polarized, moderately intense light, 30 or more rings can be seen. With weakly polarized light of the same intensity, only a few rings, perhaps 6 to 8, are visible. This device, then, provides a rough but ready estimate of the degree of polarization. So far no precise method of calibration has been attempted.

The interference pattern further indicates the planes of the e and h vectors of the polarization. As mentioned in the preceding paragraph, the concentric rings are broken. The interruptions occur in quadrants and establish a right cross, the arms of which define the orientation of the polarized light traversing the analyzer. At the center of the pattern two diametrical quadrants are dark, and two are light. This relationship provides a ready means of discriminating the e and h vectors, since the position of these quadrants is

specifically related to the plane of polarization and the kind of crystal plate used.

Most of the time no close measure of the polarization angle was made. However, in a few cases, the analyzer was used with a plumb line for zenith reference and a protractor for measuring the angle. Even so, accuracies greater than $\pm 2^\circ$ to 3° would not be expected, because sights were all taken while swimming freely. At least for exploratory purposes the superiority of the present analyzer to a complicated prismatic polarimeter or a Savart plate should be obvious. Rapid, convenient, reproducible estimates of degree and plane of polarization were thereby accessible for inspection or photography.

In general the daylight reaching any observed submarine point from almost all possible directions was found to be partially polarized. The pattern of this polarization, described in detail in the following paragraphs, is shown diagrammatically in Fig. 1. There were at least two major components of this polarized light.

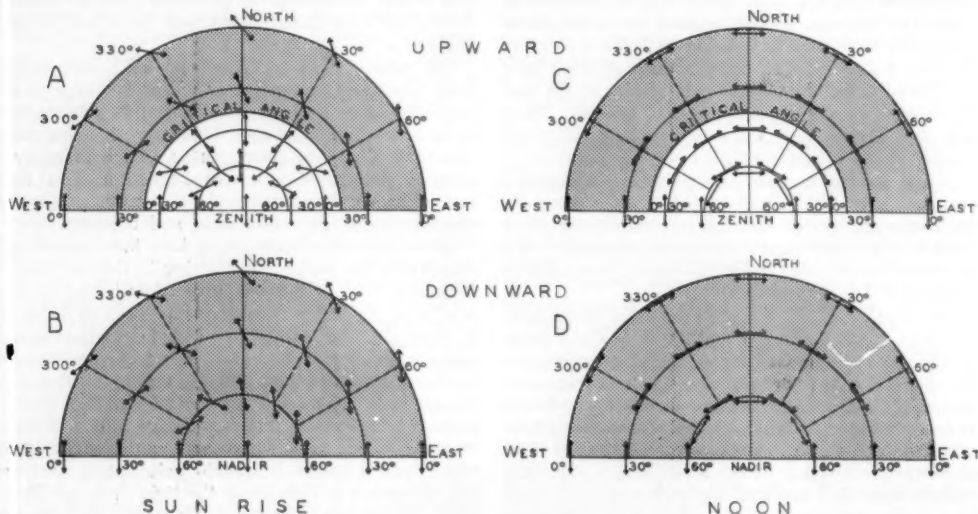


Fig. 1. Polarization planes of submarine illumination as seen from a point a few meters under water at two different times of a clear cloudless day (diagrammatic). In *A* and *B* the pattern shown is that observed at sunrise with the sun on the horizon directly east. In *C* and *D* the pattern is that observed at noon with the sun directly overhead in the zenith. The diagrams are plotted on polar coordinates with azimuths represented by radii, and elevation or depression of the observer's line of sight as concentric circles. The outermost circle (0°) in each case is the underwater horizontal—that is, the edge of a plane passing through the observer and normal to the vertical. Diagrams *A* and *C* show polarization appearing when the line of sight is raised upward toward the zenith; *B* and *D* show polarization planes seen when it is depressed downward to the nadir. In looking upward, when the critical angle (about 42° elevation) is reached, the sky and its polarization are seen, as they are at all greater elevations. The areas showing sky polarization as seen underwater are unshaded; those where the polarization is produced by sunlight in the water itself are gray. The numbers labeling angles between the critical angle and the zenith are altitudes in the sky measured from the water-level horizon (0° inside the semicircles). These are distorted by refraction, as the plot shows. In all cases the polarization planes are represented by vectors whose angular relationship to the azimuthal radius that they intersect is the same as that between the e vector of the polarized light and the vertical at the point plotted. The pattern of light polarization in the observer's other visual hemisphere would be a mirror image of that in the hemisphere diagrammed. Intensities of polarization are not represented in this figure but vary markedly as described in the text.

1) One of the components originated in the blue sky and was readily visible at depths of 5 to 6 m or less. As is well known, the surface of the sea acts as a wide-angle lens which provides about a 180° aerial field of view to an underwater observer. The whole water-level horizon and the celestial hemisphere are seen restricted within a circular area subtending an angle of just over 96° centered around the vertical. Within this area, determined by the angle of total reflection, any atmospheric polarization was readily detected and found to be the same as when observed in air except, of course, that apparent elevation was distorted by refraction and surface roughness.

For this reason then the pattern of polarization reaching any submarine point (at least within a few meters of the surface and from directions included by a 96° to 97° angle symmetrical around the zenith point) will be determined by factors the same as those influencing the sky's polarization. These primarily are relative position of the sun and amount of overcast but secondarily include distance of the point observed from the zenith, the earth's albedo, amount of atmospheric dust, multiple scattering and depolarization owing to anisotropy of air molecules (2, 11). In addition, these rays may be modified by scattering and absorption at the surface and by the water itself. However, in the present measurements, none of the numerous secondary factors had sufficient effect to be noted.

In the few observations made at 15 m, neither the sky nor its polarization was visible in the turbid water concerned.

2) The other major component of polarized submarine light, under the conditions stated, was found to arise outside of the angle of total reflection and to originate from the water itself. In depths of 5 to 6 m, this underwater polarization could be observed in all directions not included within the critical angle and a small transition region immediately outside this where some elliptical polarization appeared to be present. At 15 m this component of the polarization was seen in all directions.

This strictly aquatic polarized light was found in turbid shallow water containing much suspended matter and in the far clearer oceanic water, where the absorption coefficient would be intermediate between that of the clearest known sea water and that typical of western North Atlantic continental slope regions (12). In these highly transparent waters the degree of polarization was found to be considerably greater than in the shore areas under the same conditions of illumination. With the sun close to the zenith at the deep-water oceanic station, the water's polarization in a horizontal direction was even appreciably greater than the polarization of the sky near the horizon in the same azimuth (13). The blue of the oceanic water, however, appeared far more luminous and brilliant than that of the sky, so that quantitative comparison was not feasible by the visual method described.

Besides being influenced by the clarity of the sea water, the intensity of submarine polarization was found to be affected by the position of the sun rela-

tive to the line of sight. When the sun was close to the zenith maximum polarization was found in the water observed horizontally. Depressing the direction of vision downward toward the antisun decreased the amount of polarization to zero at the latter point which lay within the observer's underwater shadow directly below. Raising the line of sight toward the angle of total reflection also decreased the polarization to a fraction of the total light.

When, on the other hand, the sun was close to the horizon at sunrise or sunset, the distribution of polarized light intensities was quite different. Maximum polarization then was found directly downward and along an arc outside the critical angle and at all points 90° from the bearing of the sun. Minimum polarization with level lines of sight occurred in the sun's azimuth and also toward the antisolar point. Therefore in sweeping the direction of view around horizontally, the percentage of polarization varied continuously passing through minima in the bearings mentioned and maxima at azimuths 90° from the sun.

In addition to its intensity and its degree of polarization, the plane of the light's polarization was discovered also to vary systematically with the relative position of the sun and the point observed underwater. When the sun was near the zenith, the electric vector of the polarized light was horizontal and the same at all azimuths.

At sunset, on the other hand, the plane of polarization in the sun's azimuth was horizontal. As the direction of view made an increasingly large angle with the sun's azimuth the plane of polarization tilted more and more toward the west. When it was observed 90° from the sun this tilt was about 45°. Turning still farther from the sun, the westward tilt decreased to zero 180° from the sun's bearing. At sunrise a similar pattern of polarization was found, except that the slant of the polarization plane was toward the east. At either sunrise or sunset, when the observer looked directly down in the water, the magnetic vector of the polarization coincided with the great circle through the sun, the point observed and the antisolar point.

On the basis of the data reported, it seems obvious that the polarization of light underwater is primarily determined, as one might expect (8), by factors similar to those that determine the underlying pattern of sky polarization (14, 15).

In this case the degree of polarization, assuming it all to be due to isotropic molecular scattering, is given by the relationship, $P = \frac{\sin^2 \theta}{1 + \cos^2 \theta}$, where P is the fraction of total light polarized and θ is the angle between the sun's direction and the line of sight. Obviously P varies from 0, when $\theta = 0^\circ$, to 1, when $\theta = 90^\circ$. Similarly, the ϵ vector of the scattered light is at all points normal to the direction of the impinging light rays.

Note, however, that superimposed on these fundamental similarities to sky polarization the pattern of polarized light in natural waters will show an important difference—namely, as long as the light originates out of the water, the direction of the primary rays,

which are to be scattered, will be altered by refraction. The resultant amount of deflection varies with the angle of incidence. Thus with a flat calm the refractive effect at the sea surface is nil for vertical incidence. It is maximum near sunrise and sunset when the angle of incidence is 90° and, according to Snell's law, the angle of refraction is only $48^\circ 20'$ (estimated at Bermuda salinities and temperatures).

There are a number of specific observations, in addition to the general facts already presented, which give further support to the scattering theory for the origin of the primary pattern of polarized submarine illumination. Most instructive was the examination of polarized light distribution in caves and under deep overhanging ledges, where it was possible to compare the plane of polarization in water that was illuminated by direct sunlight and water that was illuminated by an aperture lighted generally by sky and clouds but not directly by the sun. In suitably chosen areas, it could be demonstrated dramatically that the direction of the penetrating illumination was the main determinant of the plane of underwater light polarization.

Thus, in one particular case, this was shown directly by my swimming a few feet from open water into water overhung by a large rock ledge. In the open split water the plane of polarization, as seen looking north and horizontally, was tilted about 35° toward the west. This tilt corresponded with the angle of refraction of the sun's rays and the direction of view. In the shaded water, where the rock overhead cut out all illumination except from the eastern third to half of the sky, there was a tilting of the e vector toward the east by 30° while the line of sight was still level and to the north. Therefore, the plane of polarization differed by 65° in these differently illuminated areas, although the sun's position and the line of sight were the same. This is a crucial observation in support of the scattering hypothesis.

Somewhat similar effects have been seen underwater on several instances when heavy overcast of limited extent obscured the direct rays of the sun. For example, on one occasion in moderately clear water, the following was observed in a horizontal direction 90° from the sun's azimuth. The sun was close to the horizon, and the plane of submarine polarization was tilted west by about 40° . While this was being observed a dense cloud drifted in front of the sun, although most of the rest of the sky was clear. At this time the tilting of the e vector became less pronounced by 10° to 15° . A return to the initial condition, when the sun again came out from behind the cloud, provided a good control.

Clearly the alteration in net direction of the total incident illumination produced a concomitant shift in the polarization. This is also supported by observations under a thick general overcast when the plane of submarine polarization was found to be horizontal in all azimuths. When the cloud cover was thin or incomplete, the obliquity of the polarization plane depended on the position of the sun and the contribution of its direct rays to the over-all underwater illumination.

Finally, some more quantitative measurements of the actual orientation of the polarization plane in the water under different specific conditions should be mentioned. At sunset the deviation of the polarization from horizontal was 48° toward the west, 90° from the sun. This is well within the observational error of the theoretical value obtained with the foregoing assumptions. Similarly, when the sun's zenith distance was 35° , the measured displacement of the interference pattern was 28° , while the predicted value on the basis of simple refraction would be 25° , again within the experimental error.

The observations described in foregoing paragraphs demonstrate that submarine illumination, at least at the depths observed, is highly polarized in patterns primarily related to the directional incident light from the sun and sky. Several additional points of interest arise from these findings. These relate, on the one hand, to problems in physical oceanography and, on the other, to the biological implications of the data.

At first glance one of the most surprising aspects of the pattern of submarine illumination is the lack of evidence that surface reflection plays any primary part in it. On the basis of simple refraction and reflection at the air-water interface, one would expect strong vertically polarized components, particularly when the sunlight is incident at Brewster's angle ($53^\circ 15'$ at Bermuda salinities and temperatures).

Vertical polarization has, in fact, never been observed underwater. The only possible part of the polarization pattern that does not seem directly related in its origin to scattering of the incident light occurred, as mentioned earlier, in an annular area near the angle of complete reflection. Here the interference pattern gave evidence of elliptical polarization of the light. This may have been related to polarization by refraction and reflection at the surface.

The absence of a marked effect of the water surface on the submarine polarization may be the result of the complex nature of the reflection, refraction, and scattering that occur there. In the first place, the surface is not usually smooth, so that simple Brewsterian reflection may not be prominent. This kind of rough surface effect may be observed in model form by comparing the polarization of reflected light by a smooth glass surface and by a scattering-reflecting surface such as the cloth binding of a book. In the former case, as in a flat calm at sea, light reflected is highly polarized horizontally and follows Fresnel's formulas. In the case of the scattering surface the polarization plane may be tilted far from the horizontal and toward the source in highly directional illumination if this is not normal to the surface in the line of sight.

Furthermore, the light reflected from the sea surface is partly polarized by the blue sky which it reflects (7, 16). Thus the surface polarization of the total reflected light and, hence, that of the penetrating light will have at least three major sources whose relative importance will vary under different conditions and angles of incidence. The present observation that the surface polarization ordinarily has a small effect on the over-all submarine polarized light is consistent

with the more general finding that surface scattering and reflection, except at high angles of incidence, have negligible effects on light penetration as a whole (8, 17).

If these surface phenomena, or any other sources of polarized light than Rayleigh scattering, are significantly involved in the polarization of underwater illumination, they should be revealed by a more detailed study of the pattern of polarized light. Interaction between light rays polarized in different planes would produce idiosyncrasies in the pattern analogous to the neutral points and lines in the blue sky (18). As mentioned earlier, such have not yet been observed underwater with the present technique.

Another matter of considerable interest is the question of how penetration into deep layers affects the polarization of submarine light. If, as the present data indicate, polarized light underwater originates mainly by Rayleigh scattering of beams of penetrating light, one would expect polarization to occur as deep as significant directionality is present. Although scattering tends to decrease directionality, most of the scattered light in sea water is directed forward (19). Photographic measurements at 400 m in very clear water demonstrated that the ratio of total horizontal to vertical illumination was still 60 percent (20). It seems clear then that directionality of illumination is maintained to great depths, in terms of the total distance of submarine penetration of light. On this basis one would predict the presence of polarization produced by Rayleigh scattering at all depths where significant light from the surface is present.

From the known data on the directionality of light penetration in general, one would also predict that the polarization pattern would become simpler and increasingly stable in time in deep water. These differences from the polarized light patterns near the surface would arise from the antagonistic interaction of scattering and absorption which eventually should produce an equilibrium pattern of illumination centering around the vertical (21).

Actual observations have shown that, while directionality is maintained, average obliquity is reduced and the angular spread of the radiation is broadened with depth (22). Thus at some depth characteristic for the optical properties of the water column concerned, the directional pattern will center about the zenith and be independent of the sun's altitude. In the clearest water this equilibrium point, which is reached gradually, has been estimated by Jerlov (22) to occur at about 300 m. In less transparent water it would occur nearer the surface. One would expect, therefore, that as depth increases, the light polarization pattern would become, at all times when there was adequate illumination, increasingly like the pattern in the upper layers, when the sun is in the zenith, or even more like that with a completely overcast sky.

The physical optic problem of the precise origin of submarine polarization by scattering is also an interesting matter that needs further study. If the scattering is molecular, then the polarization and the brilliant blue color of very clear oceanic waters are linked to-

gether as they are in the sky (9, 23). Upward scattering of daylight in highly transparent oceanic water has been found to have a maximum at 425 m μ (22). This is the value one would predict on the basis of molecular scattering by the water. On the other hand, the color of clear ocean water corresponds with the wavelength of greatest transparency, 467 m μ (22), and at least in inshore waters the scattering is predominantly the effect of transparent mineral particles (19). Perhaps the present findings on submarine light polarization may stimulate further work in this interesting and still somewhat controversial field (7, 8, 24).

Another area where further research is required relates to the whole question of the biological effects of a complex pattern of polarization such as actually occurs in natural waters. Not only is the region within the critical angle affected by sky polarization, but the water itself has a complicated pattern dependent on the obliquity of incident light. This pattern is omnipresent during the day in surface waters, and, as outlined in foregoing paragraphs, at least the part originating from scattering in the water itself probably extends with modifications into the lowest layers of the photic zone.

Since bathypelagic animals are orienting to light and undertaking extensive diurnal vertical migrations down to 600 to 800 m (25), the possibility that light polarization may be involved in such activity should not be overlooked. Above the level of the equilibrium directional distribution of light the movement of the sun through the sky and changes in sky overcast would be reflected by characteristic changes in the polarization pattern. At the present time we know that the polarization patterns are there. We also know that polarized light sensitivity and corresponding behavior patterns also occur widely in one phylum at least. To what extent the natural behavior of such animals may be modulated or initiated by these factors is still largely unknown.

To answer this question, more must be known about the physiology of polarized light sensitivity and arthropod vision in general (26). Further data on polarized light behavior patterns must be gathered, and their relationship to the distribution and migrations of planktonic animals determined. When such biological knowledge is correlated in detail with the physical optical facts, we may then look forward to an understanding of the importance of polarization patterns in submarine illumination. Meanwhile, the prospect of such correlation and evaluation should act as a stimulus to workers in the many pertinent fields of science.

This report may be briefly summarized as follows. Polarization patterns of submarine illumination in the upper layers of the sea near Bermuda have been observed by means of a sensitive detector and analyzer, which produces an oriented interference figure when traversed by linearly polarized light. Underwater polarization was found to consist of two primary components, one directly transmitted through the surface from the blue sky, the other originating in the water itself and being nearly everywhere oriented at right angles to the direction of penetrating light. As a re-

sult of their ultimate dependence on the sun's position, both of these components were found to undergo marked changes during the course of the day. The polarization arising within the water would seem to be largely accountable on the basis of Rayleigh scattering of light in the water. If this is so, the deep water pattern of polarization would most likely be similar to that near the surface on a heavily overcast day. Since a number of aquatic animals are known to be visually sensitive to polarized light, the possible relationship of the patterns described to the orientation and migration of zooplankton offers a promising area for future research.

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News and Notes

Advances in Calorimetry

Approximately 130 scientists representing more than 80 government, academic, and industrial laboratories in the United States, Canada, and Europe attended the 9th annual Calorimetry Conference, held at the General Electric Research Laboratory, Schenectady, N.Y., 17-18 Sept. The meeting included four sessions with a total of 36 papers delivered by leading calorimetrists from various branches of science. The final session consisted of informal discussions on new products and techniques in calorimetry in which the entire membership participated.

The conference program was arranged by the writer under the chairmanship of E. J. Prosen (National Bureau of Standards). Vincent J. Schaefer, director of research for the Muntalp Foundation, spoke on "Jet stream, thunderstorms and project sky-fire" before the conference dinner. David Turnbull (G.E. Research Laboratory), delivered the welcoming address and reviewed the several regions of calorimetric research in which G.E. is actively interested. Guy Waddington (Bureau of Mines, Bartlesville) delivered the

first of a series of lectures that will hereafter be given annually and will be known as the Hugh M. Huffman memorial lectures in honor of the late Dr. Huffman, organizer and first chairman of the conference. Dr. Huffman's work, his contributions, and their significance to the field of thermochemistry were summarized. Some of this work has formed the "basis of master tables" of thermodynamic properties. Other features of the lecture referred to technical advances in thermochemistry, such as the "rotating bomb," and to the problems and accomplishments in the thermochemistry of compounds containing sulfur, halogens, and fluorocarbons.

The latest developments and modifications in high-precision bomb calorimetry were reported in a series of three papers that were a part of the first session. A. K. Meetham (National Physical Laboratory, England) described N. P. L. No. 1 bomb calorimeter. Some of the special features reported were (i) a simple method of ignition, (ii) complete sealing of the calorimeter, and (iii) a numerical method of correction for heat transfer. The second rotating bomb calo-

rimeter designed and built at the Bureau of Mines (Bartlesville) was discussed in a paper by D. W. Scott, W. D. Good, and W. N. Hubbard. Some of the improvements that were emphasized were a direct line of the rotating mechanism for revolving the bomb directly, the use of a standard calorimetric-type resistance thermometer, and modification in the design of the jacket lid.

The technique used for determining the combustion heats of some organic metallic compounds was described by P. Waszciek, R. E. Miller, and H. Stange (Mathieson Chemical Corp.). Results were reported for several borane compounds.

The latest developments in cryostat designs for measuring heat capacities from below 1°K to room temperature were discussed in four papers. D. H. Andrews (Johns Hopkins University) described a unit designed for measuring thermal capacities of liquids and liquid mixtures. The calorimeter heating is continuous and the adiabatic control is automatic. The specific heats of sodium, potassium, and rubidium have been measured in the temperature range of 13° to 325°K. According to H. Preston-Thomas (National Research Laboratories, Ottawa), the data were obtained from an adiabatic calorimeter where the heat input to each specimen was continuous; all results were recorded graphically. Accuracy of 0.1 percent can be attained when the temperature difference between the shield and the sample is kept within 3×10^{-4} deg. Specific heat curves of sodium and rubidium appear with anomalies of the order of $\frac{1}{2}$ and 2 percent. An adiabatic calorimeter for measuring specific heats in the temperature range of 2.5° to 20°K has been used by J. S. Dugdale, J. A. Morrison, and D. Patterson (National Research Laboratories, Ottawa) on studies concerning the effect of particle size on specific heat. The Simon expansion method of producing liquid helium has been adapted. Adiabatic control is manual. The "difference" thermocouple consists of Ag-Au versus Au-Co.

Calorimetry below 1°K was discussed by J. G. Daunt and G. deVries (Ohio State University). Measurements on the specific heat of liquid helium 3 in this temperature range have been made. Among the several unique features reported were the design (and operation) of a superconducting thermal valve.

Microcalorimetric methods applied to the study of stored energy, recrystallization energies, and lattice imperfections were presented to the conference in three papers. A. W. Overhauser (Cornell University) has designed and constructed two microcalorimeters. The first unit has a fast adiabatic jacket, making it adaptable for measuring the release of stored energies for fast annealing. The second unit measures energies for annealing due to radiation damage. Approximately 0.01 cal energy release over a temperature range of -140°C to room temperature can be measured to an accuracy of 10 percent. The sensitivity of the apparatus is about 10^{-5} cal/deg.

The measurement of energy of recrystallization of

copper, using a Borelius-type isothermal-jacketed microcalorimeter, was presented by Paul Gordon (University of Chicago). The apparatus has been used to study the isothermal annealing of high-purity copper after room temperature deformation. The limit of detection is a heat flow of 0.003 cal/hr. It is claimed that the absolute accuracy of the determinations is usually in the vicinity of from 2 to 5 percent. A twin adiabatic microcalorimeter for measuring stored energy in metals has been designed and operated by F. B. Riggs, Jr. (Harvard University). The instrument compares the temperatures of a "passive" thermal mass and an "active" thermal mass when both are supplied with the same power. Temperature difference between the two specimens is detected by means of a 30-junction thermopile; 10 μ cal suddenly released in 25 g of material can be detected.

The application of calorimetric methods to the study of ordering in magnetic systems was the subject of three papers. J. W. Stout and E. Catalano (University of Chicago) presented thermal capacity data showing the thermal anomalies associated with the antiferromagnetic ordering in the difluorides of manganese, iron, cobalt, and nickel. By utilizing data on the isomorphous compound ZnF_2 , the contribution of the lattice was estimated by a "corresponding states" argument, and the entropy change and the heat capacity arising from the antiferromagnetic ordering in the paramagnetic salts were calculated. L. D. Roberts and R. Murray (Oak Ridge National Laboratory) reported measurements in the temperature range of 1° to 4°K of the thermal capacity and magnetic properties of UCl_3 and $MnCl_2$. Both of these salts exhibit maxima in thermal capacity and anomalies in magnetic properties near 2°K, but the data are not explainable in terms of existing theories of antiferromagnetism. In UCl_3 there is a large magnetic contribution to the thermal capacity at temperatures well above the maximum, and in $MnCl_2$ two thermal capacity peaks are found. Data on thermal effects in nickel-zinc ferrites were presented by E. F. Westrum, Jr. (University of Michigan). Thermal capacity measurements between 5°K and room temperature showed nothing anomalous in a ferrite where the ratio of zinc to nickel was 1.5. But, as this ratio was increased, thermal anomalies accompanied by a slowness in attaining thermal equilibrium became evident at the lower end of the temperature range (presumably associated with a magnetic contribution to the heat capacity).

Two papers dealt with calorimetric investigations and superconductivity. The results of measurements on lanthanum in the temperature range of 1.6° to 6.3°K were presented by A. Berman, M. W. Zemansky, and H. A. Boorse (Columbia University). Data indicated that the samples used were a mixture of hexagonal and cubic modifications that have different transition temperatures. In a magnetic field of 600 oersteds, the thermal capacity is a smooth function of the temperature, coinciding with the zero field data at temperatures above the upper transition. On a plot of

C/T vs. T^2 , the data are not linear and cannot be interpreted as a linear electronic term plus a T^3 lattice term with a constant Debye θ . An investigation of the specific heat of superconducting vanadium by W. S. Corak, B. B. Goodman, C. B. Satterthwaite, and A. Wexler (Westinghouse Research Laboratories) showed that the electronic contribution to the specific heat is better represented by an exponential function than by the T^3 dependence previously deduced.

A precision calorimeter for measuring small differences in heats of alloy solutions in molten tin was described by J. S. L. Leach (Massachusetts Institute of Technology). The calorimeter has been intended primarily for measuring energy retained in metals and alloys after cold working. The unit has been used to measure the heats of formation and the heats of solution in tin. A new reaction calorimeter, quasi-isothermal in design, has been designed and constructed by O. J. Kleppa (University of Chicago). Certain features of the calorimeter make it particularly suitable for studies up to 500°C involving heats of mixing and heats of solution in alloy systems.

Michael Hoch and H. L. Johnston (The Ohio State University) have obtained heat content data on Ta, W, Al_2O_3 , ThO_2 , and TaC between 1000° and 3000°K. Although there is agreement with previous work in the overlapping regions (300° to 1700°K), the extrapolation of this earlier work in the temperature range of 2000° to 3000°K gives much higher figures than the measured values. Based on the new values in the high temperature region, reliable extrapolation has now been made. R. A. Oriani and W. DeSorbo (G.E. Research Laboratory) reported on the thermal capacity of a single-solution alloy $\text{Au}_{52}\text{Ni}_{48}$ in the temperature regions 13° to 1190°K by means of a low-temperature isothermal calorimeter (Giauque-Johnston type) and a Bunsen drop calorimeter. The change in thermal capacity that accompanies the formation of the solid solution from pure gold and nonmagnetic nickel has been evaluated, and it has been shown to be positive over the entire temperature range.

If one considers interactions between the nearest and next-to-the-nearest neighbors only, the Born-von Karman theory of specific heats requires only two constants to characterize the contribution of the lattice to the atomic heat. J. R. Clement (Naval Research Laboratory) described a simple method for determining empirically the values of these constants from calorimetric data alone. The theoretical procedure was outlined, and a comparison was made between theory and experimental data for fcc and bcc lattices.

Low-temperature calorimeters (both isothermal Nernst-Giauque and adiabatic) play a leading role in the study of surface phenomenon on solids. E. L. Pace (Western Reserve University) has used them in making measurements on adsorption isotherms, heats of adsorption, and thermal capacity of simple gases adsorbed on finely divided nonporous surfaces. The calorimetric data have been used to determine the energy distribution at the adsorption sites and the zero-point entropy. A calorimetric method for the measurement

of heat transfer by radiation and gas conduction between room temperature and 77°K was described by F. J. Zimmerman (Arthur D. Little, Inc.). It was found that buffing or polishing plated surfaces increases the heat transfer by radiation. The best surface for minimizing radiation heat transfer was found to be silver lume.

Energetics of high-polymer solutions and polymerization problems were the topics of two papers. Marcel Rinfret (University of Montreal) described a conduction microcalorimeter for the determination of heats of solution of high-polymers; and B. R. Thompson described an isothermal calorimeter that utilizes the heat-flow method and is used for the study of heats of polymerization for systems under pressure. Thompson also described a simple adiabatic calorimeter that is used to follow the course of the polymerization in sealed glass tubes where conventional techniques are not applicable. Edward Wickers (National Bureau of Standards) reviewed briefly (i) three types of reference materials prepared by NBS at the request of the Calorimetry Conference for the precise intercomparison of thermal capacity calorimeters; (ii) materials available for standardizing combustion calorimeters; (iii) thermometric standards. The conference committee for handling requests for the various calorimeter standards available from the NBS consists of E. J. Prosen (NBS) and W. DeSorbo.

The final session of the conference was devoted for the most part to an informal "experience discussion" and presentation of new products and techniques. J. R. Clement presented data on the thermal capacity of a 1-w carbon resistor (Allen Bradley Co.) and also on a simple method for deducing temperature values from resistance data utilizing a two-constant formula. According to Clement, this method affords the best means yet found for making the interpolation in calibration data between 4.2° and 10° K. He also announced the resistance temperature characteristic and reproducibility of a new 0.1-w resistor of smaller physical size than was heretofore available, and that is now commercially available (Allen Bradley Co.). Utilizing the results of a series of recent investigations that have brought the temperature scale closer to the true thermodynamic scale, Clement also reported changes in calorimetric data previously based on earlier scales. Vapor "oscillations" have been found to affect the vapor pressure of low-temperature liquids. Their influence on the accuracy of the temperature scale was also pointed out by Clement.

An automatic bath temperature-control unit operable in the temperature region 1.5° to 20°K was discussed by M. D. Fiske (G.E. Research Laboratory). In the liquid helium region the vapor pressure of the refrigerant can be controlled to a constancy of $\pm 0.0005^\circ\text{K}$. In the hydrogen region the control is even better. J. N. Ratti (Engineering and Research Corp., Riverdale) spoke on both shield and temperature-control units with a servomechanism for higher-temperature refrigerant liquids. C. V. Heer, C. B. Barnes, and J. G. Daunt (Ohio State University) described

the extension of isothermal calorimetry techniques to temperatures as low as 0.2°K by the use of the magnetic refrigerator. Copper wire-inserted glass tape (Atlas Asbestos Co.) is finding its use in the construction of low-temperature calorimeters, according to G. T. Furukawa (NBS). J. M. Berry (G.E. Research Laboratory) discussed the thermoelectric stability of different thermocouple materials for use in high-temperature calorimetry as well as the thermoelectric effects of strain, both elastic and plastic, on the thermal emf. F. B. Riggs (Harvard University) told the group about gold thermopile leads for high-temperature microcalorimetric investigations. C. R. Droms (G.E. General Engineering Laboratory) demonstrated a simple circuit that converts the nonlinear thermistor characteristics to essentially linear dial readings on a bridge. R. A. Oriani mentioned details of a high-temperature differential solution calorimeter now under construction.

The conference unanimously adopted the following recommendation to the National Bureau of Standards concerning the extension of the international temperature scale to liquid helium temperatures.

The use of temperatures below the boiling point of oxygen in pure and applied research has increased several fold within the past decade. The development of the Collins Helium Cryostat has played a major role in making this temperature range available. Most of these cryostats are now in service in the United States, but several are also in service in foreign countries. The measurement of temperature in this range is of primary importance to the value of the work accomplished and is international in scope.

The need for fixed temperature points and mathematical relationships between resistance and temperature below the boiling point of oxygen is a growing one. The establishment of an accurate temperature scale in this temperature region should be investigated by a standardizing laboratory of international standing. The National Bureau of Standards has as one of its functions the establishment and maintenance of thermometric standards and is uniquely fitted to undertake the investigations required to provide an accurate scale of temperature in the region below the oxygen point. It is recognized that the temperature region below 10°K may require the utilization of temperature-sensing devices that will differ in nature from the instrument used in the range 10°K to the oxygen point. The members of the Calorimetry Conference therefore recommend that the National Bureau of Standards undertake investigations aimed at providing the following urgent needs of American scientists: (i) An accurate temperature scale from 10°K to the oxygen point. (ii) A provisional temperature scale and standard thermometers to cover the range 0.1° to 20°K .

At the business meeting held at the beginning of the last session, E. F. Westrum, Jr., became chairman-elect and D. R. Stull was reelected director for a 2-yr period. Other members of the board of directors for 1954-55 are Warren DeSorbo as chairman, J. W. Stout, E. J. Prosen, and Guy Waddington.

WARREN DESORBO

General Electric Research Laboratory,
Schenectady, New York

Science News

The skullcap of Saldanha man was discovered by K. Jolly and R. Singer in 1953 at Hopefield, South Africa. In a recent number of the *American Anthropologist* [56, 879 (Oct. 1954)], M. R. Drennan reports on Saldanha man and his archeological and paleontological associations. The site of discovery has yielded hand axes characteristic of the South African Earlier Stone Age, as well as other stone implements typical of the Middle Stone Age. Drennan regards Saldanha man as the maker of the hand axes, particularly since the associated fossil assemblage suggests great paleontological age. These fossils include the extinct Cape horse, giant bush pig, African mammoth, and primitive giraffe, and also existing rhinoceros, hippopotamus, and antelopes. The fluorine content of the Saldanha skull agrees with that of the older extinct mammals and is comparable to that of European Acheulean bones.

The thick human skullcap has an estimated cranial capacity of 1200-1250 ml. Although somewhat resembling those of European Neanderthal skulls, it bears a greater likeness to the brain-case of Rhodesian man. The nuchal plane is inclined backward as in Neanderthal skulls, a feature which Drennan regards as indicating a crouching posture; in this respect it differs from the Rhodesian skull, in which the nuchal plane is disposed horizontally as in *Homo sapiens*. The Saldanha brain-case especially resembles the Rhodesian in its massive and shelving brow ridges, skull breadth, and coronal contour. Drennan, although recognizing that the incompleteness of the skull forbids taxonomic dogmatism, regards the Saldanha specimen as a primitive proto-Australoid type whose closest affinities are with the Rhodesian skull, from which it seems to differ to the extent of being a regional variety, and as possibly a more primitive forerunner of the Rhodesian race. In the absence of the facial skeleton, however, one can accept any suggested special relationship to Rhodesian man only with great reservation; for there is ample evidence of a rather low degree of correlation between facial and brain-case morphology in Pleistocene man. It is to be hoped that the industry and perseverance of Prof. Drennan and his associates will be further rewarded by additional and more complete human material.—W. L. S., Jr.

Each American citizen contributes slightly more than 2 ct/yr toward support of the World Health Organization.

A survey to learn public reaction to science news reporting is being launched by the National Association of Science Writers. It will be directed by Hillier Kriegbaum, associate professor of journalism at New York University. Financed by a \$10,000 grant from the Rockefeller Foundation, the study is designed to help make science news meaningful to the public.

The NASW plans to engage a professional fact-finding organization to poll the attitudes of a nation-

wide cross section of the public toward science reporting by newspapers, magazines, television, radio, and motion pictures. Previously, the NASW and NYU have surveyed the attitudes of editors and scientists.

A 6-wk oceanographic cruise in the Gulf of Alaska was made in August and September aboard the R. V. *Brown Bear* by a group of investigators from the department of oceanography of the University of Washington, Seattle. Nine scientists and technicians under the leadership of Robert G. Paquette participated in the expedition, for which Richard G. Bader and Herbert F. Frolander, respectively, were in charge of the geologic and biological work. This survey cruise, sponsored by the Office of Naval Research, was the first to cover the entire gulf and should give a good general picture of the oceanographic conditions during summer.

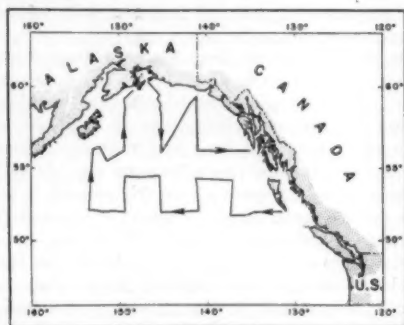


Fig. 1

Sixty stations were occupied in the area bounded by the coordinates 52°N, 154°W, and the coasts of Alaska and British Columbia (Fig. 1). Measurements were made of salinity, temperature, dissolved oxygen, and inorganic phosphate to depths as great as 5000 m. In addition, currents were measured with the geomagnetic electrokinetograph, the entire area was systematically sampled for plankton, and—with a gravity-type corer—a number of sediment samples were taken from the shelf, and from the tops of sea mounts in the deep oceanic areas. A continuous echo-sounding record was kept over the entire cruise track.

Preliminary indications are that the existence of a counterclockwise circulation of surface water in the Gulf of Alaska will be confirmed and established in greater detail than previously. The zooplankton concentrations were relatively high, and show a distinct correlation with the water properties and probably with the depth of the deep scattering layer. The microfauna and composition of the sediments should supplement existing information on paleoecology, climate, and sediment distribution. The results of the survey will be published in the appropriate scientific journals.

The American Nurses Association recently disclosed that its Georgia affiliate is the only one that still bars Negroes from membership.

Successful transplantation of the thyroid gland from the neck of a dead infant to the groin of a 29-yr-old woman was reported by Julian A. Sterling and Ralph Goldsmith of the Albert Einstein Medical Center, Philadelphia, at the recent meeting of the American College of Surgeons. The operation to remove the gland from the 21-day-old baby started 1 hr after the child's death; 5½ hr later the major blood vessels of the stem of the gland had been stitched to the blood vessels in the young woman's groin and the final dressing had been bandaged on her wound.

The patient had had her own overactive thyroid gland removed 10 yr previously. Immediately after this, symptoms of tetany with spasms, trembling, and muscular pains developed. She had to take vitamins and thyroid extract one to five times a day and calcium salts by injection into veins as often as four times a day. Apparently the parathyroid glands had been removed along with the thyroid. Attempts to correct this by transplanting parathyroid glands failed. The grafting of the baby's thyroid was done 2 yr ago. Since then the young woman has been well and happy and able to do her own housework. The only medicine she takes is an occasional oral dose of calcium.

The urgency of a national program for the development and conservation of "our most precious resource, the limited number of young people with high ability," was recently stressed by Alan T. Waterman, director of the National Science Foundation, before the House Subcommittee on Educational Activities. Waterman indicated that, in the long run, improvement in the quality of scientific and technical training is as important as a sufficient increase in the number of those trained. A serious problem exists in the lack of sufficient scientific manpower, and the year 1954 represents the low point in college graduations, reflecting the low birth rate at the depth of the depression. From now on the number of graduations will increase so that by the 1960's, when the children born in the 40's graduate from college, a doubling in the output of college graduates is expected. The need then will be even greater. Waterman stated:

The task before us in maintaining the quality of training of this great increase in enrollments is one of the most serious problems facing us in maintaining economic and defensive strength.

Waterman called attention to the all-out effort by the Russians to increase their supply of scientists and engineers and outlined in broad strokes efforts underway by the National Science Foundation to develop a U.S. program for producing an adequate supply of scientists and engineers. In particular, he pointed to the necessity for assuring a sufficient number of teachers and for improving science instruction in the secondary schools and in many of our colleges and universities.

As an indication of our present manpower potential, Waterman quoted recent statistics showing that less than half of the top quarter of high school graduates

now complete college. Although economic factors may play a part in this situation, he stated that lack of adequate motivation to continue advanced training is also a major factor. The foundation is currently attempting to determine what other factors are at work and how to meet them.

The U.S. Atomic Energy Commission has presented the Japanese Government with a complete technical library of unclassified and declassified literature on atomic energy. The Ministry of International Trade and Industry is the governmental agency responsible for atomic energy matters in Japan.

The gift library consists of 10,000 AEC research and development reports, 3000 of which are on micro-cards; 28 bound volumes of the commission's National Nuclear Energy Series; nine bound volumes of abstracts of some 50,000 technical reports and articles from this country and abroad; and 25,000 sets of index cards and other material. The collection is a duplicate of the material now available in 42 repository libraries in the United States. The Japanese Government will receive the same additions that are made from time to time to the American libraries.

A survey conducted by the Agronomic Manpower Resources Committee of the American Society of Agronomy reveals that this country's crop and soil scientists have many special skills that are useful to the nation in wartime. Information was obtained from questionnaires answered by those scientists who had received their college degrees after 1941. The greatest number listed themselves as trained to supervise the production of food. Other categories checked most frequently were supervision of the establishment of suitable vegetation at military airports, development and production of chemurgic and textile plants, participation in wartime chemical research and wartime chemical industry, advising on efficient utilization and distribution of basic fertilizer materials, and soil mapping for trouble areas.

The questionnaire also revealed that 95 percent of the scientists with master's degrees served at least 3 yr in the armed forces during World War II; the percentage was 77 for those with doctor's degrees. In the report on the survey it was made clear that crop and soil scientists are not asking for special privileges. However, they do ask that their talents be used in jobs for which they are especially trained, either in a military or a civilian capacity, and not be indiscriminately wasted, as was so often the case during the last war.

In the October *Journal of Chemical Education* Martin Levey of Pennsylvania State University traces the origin of the manufacture of soap back more than 5000 yr. He points out that the earliest soaps "were made for medical purposes and for the washing of wool but not for general detergent use." Soda and potash from plant ash were the most common washing agents from early antiquity until the middle of the 19th century.

President Eisenhower reaffirmed his opposition to socialized medicine as he accepted the Frank H. Lahey memorial award for "outstanding leadership in medical education." The President said that he was interested in raising private funds to help medical schools "because this is one profession we don't want to get under the dead hand of bureaucracy." The award is sponsored jointly by the National Fund for Medical Education, the American Medical Association, and the Association of American Medical Colleges.

Two facts about the nation's dental health were made clear at the recent annual meeting of the American Dental Association. First, despite steady advances in dental science and availability of dental services, there is still a tremendous backlog of dental neglect. More than 90 percent of children have one or more decayed teeth by the time they reach school age. At the age of 15 yr, more than 95 percent have decayed permanent teeth, and the average child has lost two teeth because of lack of treatment. The average adult has lost half his teeth by the time he reaches 40. Less than one-third of the American people, it is estimated, received adequate dental services.

The second and equally significant fact is that there seems to be little possibility of substantially remedying this situation in the near future. Today there are about 85,000 active dentists in civilian life, approximately half the national total of physicians. Some 6300 are in the armed forces, and 900 are employed by the Veterans Administration, 300 by the Public Health Service, and 200 by health departments.

Because enrollment in dental schools was low in the depression years, a disproportionately small number of dentists are in the 30- to 40-yr age group. More than 45 percent of our dentists are 50 yr old or older, as compared with 38 percent of the physicians. Although the total supply of dentists has increased considerably since 1941, the gain has not kept pace with population growth.

On 12 Nov. a coelacanth was captured alive in the Comoro Islands, off northern Madagascar. Several specimens of this primitive "fish," an important link in the evolution of mammals, have been caught previously, all off the Comoro Islands, but this is the first one to survive capture.

Following Lodge's report to the United Nations that the United States will allocate 220 lb of fissionable material to the international agency that the President has suggested to carry out his atoms-for-peace proposal, Britain announced a contribution of 44 lb. An editorial in the 17 Nov. issue of the *New York Times* points out that although 264 lb is not really very much, especially when it is to be distributed among a considerable number of small experimental reactors in different countries, nevertheless, "the outright gift of fissionable material probably worth several millions shows that the President is willing to support a program with deeds that will surely be received with enthusiasm. . . ."

Scientists in the News

Enrico Fermi, 1938 Nobel prize winner and professor of physics at the Institute for Nuclear Studies, University of Chicago, has been named recipient of the first special award by the U.S. Atomic Energy Commission. The Atomic Energy Act of 1954 authorizes such awards for "especially meritorious contributions for the development, use, or control of atomic energy." The award to Fermi, which was recommended by the AEC General Advisory Committee and approved by President Eisenhower, is \$25,000. It will be accompanied by a citation noting Fermi's contributions to basic neutron physics and the achievement of the controlled nuclear chain reaction.

Fermi's accomplishments in physics, and in particular his contributions to the development of atomic energy, have been of tremendous importance. The Fermi-Dirac particle statistics, the theory of beta-decay, the Fermi-Thomas model of the atom, neutron-induced radioactivity, and a theory of the origin of cosmic rays, are included among his experimental and theoretical works.

An Italian-born pioneer in nuclear studies, Fermi designed and directed construction of the first atomic reactor. It was built on a squash court at the university's stadium, where on 2 Dec. 1942 the first nuclear chain reaction took place.

Fermi directed the advanced physics division of the Los Alamos laboratory during World War II. After the war he was for several years a member of the AEC General Advisory Committee. He was a wartime colleague of J. Robert Oppenheimer at Los Alamos and testified for Oppenheimer at AEC hearings earlier this year.

Dr. Fermi, 53, died of cancer on 28 Nov. In a statement to the press Lewis L. Strauss, chairman of the AEC described him as "one of the world's greatest atomic physicists."

Ernest H. Volwiler, president and general manager of Abbott Laboratories, Chicago, is to receive the Industrial Research Institute medal for 1955. The medal is awarded annually to honor "outstanding accomplishment in leadership in or management of industrial research which contributes broadly to the development of industry or the public welfare."

G. T. Anderson, president of La Sierra College, Riverside, Calif., has become the ninth president of the College of Medical Evangelists, Loma Linda and Los Angeles, Calif. He succeeds **W. E. Macpherson**, who has been appointed to the deanship of the School of Medicine that was left vacant when Harold Shryock resigned in August.

Joel E. Hildebrand of the University of California delivered the 1954 Treat B. Johnson lectures in the department of chemistry of Yale University during the period 26 Oct. through 5 Nov. His subject was the "Theory of liquids and solutions."

Paul M. Doty has been named Wallace H. Carothers research professor of chemistry at Harvard University for 1955-56. During the year Doty will devote full time to his continuing research on large molecules, particularly the relation of the structure of nucleic acids and polypeptides to their biological function. **Peter J. W. Debye**, emeritus professor of chemistry at Cornell University and winner of the Nobel prize in chemistry in 1936, will take over Doty's teaching duties for the year.

The Carothers research professorship was founded by the Du Pont Co. in 1951 in honor of Wallace Hume Carothers, inventor of nylon. Dr. Carothers served as instructor in chemistry at Harvard from 1926 to 1928. He died in 1937.

Alfred E. Livingston, formerly of the College of Pharmacy, Philadelphia, has been appointed professor of pharmacology in the College of Pharmacy at St. John's University, Brooklyn. Livingston, who has devoted more than 40 yr to teaching in medical schools, served from 1929 until 1950 as chairman of the department of pharmacology at Temple University.

Vernon M. Setterholm, who has been associated with Vitro Corp. of America since 1947, has been appointed associate director of the company's Silver Spring (Md.) Laboratory.

Jean Redman Oliver, pathologist, and **Arnold Eggerth**, microbiologist, both of whom retired on 1 Sept. from the State University of New York College of Medicine in Brooklyn, have been named professors emeriti "in recognition of their outstanding professional endeavors and many years of loyal service to the College." Having completed 25 and 35 yr of service, respectively, the two men joined the college when it was still the Medical College of the Long Island College Hospital. During their service they witnessed two major changes in the college's status—one in 1930 when it became separately incorporated as the Long Island College of Medicine, and the other in 1950 when it became one of the constituent units of the State University of New York.

Oliver, who was appointed the first Distinguished Service Professor in the State University last fall, is internationally known for kidney research. In 1939 he published his "Architecture of the kidney in chronic Bright's disease," and 2 yr later he developed a technique of microdissection that made possible the application of Richard's puncture procedures to the mammalian kidney. His experiments comprise the fundamental direct observations on which the mammalian renal physiological theory is based. Last October he received the 1953 Borden award for "outstanding research in medicine" at the Atlantic City convention of the Association of American Medical Colleges.

Eggerth, who has the longest record of service on the college faculty, has endeared himself to thousands of students. As guest of honor at the annual alumni dinner in May, he was presented with a scroll testi-

fyng to the admiration and affection that his former students feel for him. Although retired from the faculty, Eggerth will continue in active association with the college, assisting **Jean A. Curran**, recently appointed professor of the history of medicine, in the organization of a new department of historical and cultural medicine. At present Eggerth is writing a history of the Hoagland Laboratory, the college's oldest building and the first privately endowed laboratory for research in bacteriology in the United States.

Selman A. Waksman, microbiologist of Rutgers University who earned a Nobel prize in 1952 for his discovery of streptomycin, has received the Award of Honor from the American Jewish Congress for his "epochal contribution to medical science and his dedicated and continuing service to the advancement of human welfare."

John T. Goodwin, formerly of the General Electric Co., has been appointed manager of the chemistry research division of the Midwest Research Institute. Goodwin has been closely associated with the development of silicones, the group of synthetic materials widely used in lubricants, synthetic rubbers, polishes, and many similar products.

On 1 Oct. **Mario Stefanini**, formerly of the New England Center Hospital, Boston, joined the department of medicine, University of Louisville School of Medicine.

Andrew E. Buchanan, Jr., has been promoted from assistant general manager to general manager of the Du Pont Co.'s textile fibers department. He succeeds **Robert L. Richards**, who will become a member of the board of directors, a vice-president, and a member of the executive committee.

The following appointments to the scientific staff of the medical department at Brookhaven National Laboratory, Upton, N.Y., have been announced.

John L. MacIver, Jr., until recently a flight surgeon in the U.S. Navy, division of industrial medicine.

Richard I. Weller, division of medical physics. He was formerly on the physics faculty of Brooklyn College and the Maritime College at Fort Schuyler, N.Y.

Herschel Sandberg, formerly a resident in medicine at Albert Einstein Medical Center, Philadelphia, division of physiology and assistant physician to the hospital.

Walton W. Shreeve, who has completed a tour of duty as head of the Isotope Laboratory at the U.S. Naval Hospital, Oakland, Calif., division of biochemistry and physician to the hospital.

William H. Perkins, formerly instructor in medicine at the University of Arkansas, division of physiology and assistant physician to the hospital.

Eugene P. Cronkite, who was head of the hematology division of the Naval Medical Research Institute at Bethesda, Md., division of pathology.

The Penrose medal, the highest honor conferred by the Geological Society of America "in recognition of outstanding original contributions and achievements," has been awarded to **Arthur F. Buddington** of Princeton University's department of geology. He was chairman of the department from 1936 to 1950, when he resigned to devote more time to research and teaching. In World War II, Buddington served with the National Defense Research Commission and later as the principal geologist in charge of the study of iron ore potentials in New York, New Jersey, and Pennsylvania.

William T. Nichols, previously at the Monsanto Chemical Co., and a past president of the American Institute of Chemical Engineers, has recently joined the staff of Arthur D. Little, Inc.

K. C. Black, formerly of the Polytechnic Research and Development Co., Brooklyn, N.Y., has been made head of Raytheon Manufacturing Co.'s communications engineering department.

Carl F. J. Overhage, Jr., assistant director of the color technology division at the Eastman Kodak Co., Rochester, N.Y., has been appointed a technical division head at the Lincoln Laboratory, Massachusetts Institute of Technology.

Frank J. Orland, who has been associated with the University of Chicago since 1935, has been appointed director of the university's Walter G. Zoller Memorial Dental Clinic. He succeeds **J. Roy Blayney**, the clinic's head since its founding in 1936. Orland is also an assistant professor of microbiology whose research work has been concerned with dental caries and with oral microbiology. The Zoller Clinic has been carrying on several major research projects, including the Evanston fluoridation study and the collaborative study with the Lobund Institute of the University of Notre Dame on basic mechanisms in dental caries.

King D. Bird of the Cornell Aeronautical Laboratory, Inc., has been promoted to head of the newly formed Operations Branch of the laboratory's 12-ft, variable density wind tunnel. He will be responsible for all phases of engineering, planning, and testing of models in the tunnel. The new branch will provide a tie between project engineering, operations, model set-up, and design.

Among recent appointments to the staff of the Argonne National Laboratory, Lemont, Ill., are **Marcel W. Nathan**, chemical engineering; **Robert J. Epstein**, electronics; **Ambrose D. Barton**, **Anna K. Barton**, and **Edward W. Daniels**, biological and medical research.

Norman Applezweig Associates, consulting biochemists of New York City, have appointed **Marvin Cook**, former chief chemist of June Dairy Products Co., Inc., as director of their Food and Flavor Laboratories.

Necrology

Charles F. Batchelder, 98, naturalist, author, editor, and associate in mammalogy and ornithology at Harvard University Museum of Comparative Zoology, Cambridge Mass., 7 Nov.; **Albert F. Blakeslee**, 80, research botanist and geneticist, former president of the AAAS, visiting professor of botany and director of the Smith College Genetics Experiment Station, Northampton, Mass., 16 Nov.; **Ambrose G. Bricks**, 56, chemist with the United States Metals Refining Co., Carteret, N.J., 10 Nov.; **George A. Campbell**, 83, mathematical physicist, inventor, and pioneer in electric communications research with Bell Telephone Laboratories, Upper Montclair, N.J., 10 Nov.; **Edward S. Cowles**, 75, psychiatrist, neurologist, author, and former head of the department of psychopathology at the Polyclinic Medical School and Hospital, New York, 16 Nov.

Joshua D'Esposito, 76, chief engineer of the Chicago Union Station project, former state engineer for the Public Works Administration, and federal project engineer on the Chicago subway, 16 Nov.; **Leslie E. Dills**, 54, associate professor of economic entomology at Pennsylvania State University, State College, 5 Oct.; **George C. Dunham**, 67, retired director of the health and sanitation division of the Inter-American Affairs Organization, San Francisco, 4 Oct.; **Louise H. Gregory**, 74, professor emeritus of zoology and former acting dean of Barnard College, New York, 1 Nov.; **Morris E. Gross**, 57, dentist, author, and lecturer, Brooklyn, N.Y., 5 Nov.; **William P. Healy**, 76, cancer specialist, past president of the American Gynecology Society, and former dean of the Fordham University medical faculty, New York, 7 Nov.; **Walter J. Jebens**, 49, chemical engineer for the Bakelite Co., Bound Brook, N.J., 13 Nov.

Mack C. Lake, 64, mining engineer, geologist, and retired president of the Orinoco Mining Co., San Francisco, 9 Nov.; **Jan A. Linder**, 61, illumination engineer and inventor with the Westinghouse Electric Co., New York, 6 Nov.; **Emma O. Lundberg**, 73, first director of the social service division of the Children's Bureau, U.S. Dept. of Health, Education, and Welfare, Washington, D.C., 17 Nov.; **John McCall**, 31, University of Alaska glacier specialist, Fairbanks, 5 Nov.; **James H. McGregor**, 82, anthropologist, professor emeritus of zoology at Columbia University, and associate in human anatomy at the Museum of Natural History, New York, 14 Nov.; **James L. Morrison**, 41, associate professor of pharmacology at Emory University, Atlanta, Ga., 3 Nov.; **Harris P. Mosher**, 87, throat and nose specialist, former president of the American Otological Society, and inventor of surgical instruments, Marblehead, Mass., 4 Nov.

Howard W. Odum, 70, sociologist, psychologist, founder and former director of the Institute for Research in Social Science, former president of the American Sociological Society, author, founder and editor of *Social Forces*, and retired professor of sociol-

ogy at the University of North Carolina, Raleigh, 8 Nov.; **Arthur W. Pence**, 56, commanding general of the Army Corps of Engineers Center at Fort Belvoir, Va., 8 Nov.; **Charles S. Prest**, 79, pioneer in public health work and tuberculosis control measures, lecturer, and managing director of the Brooklyn Tuberculosis and Health Assoc., N.Y., 11 Nov.; **Francis S. Schwenker**, 50, pioneer in sulfa therapy, president of the Society for Pediatric Research, professor of pediatrics and director of the Harriet Lane Home at Johns Hopkins Hospital, Baltimore, 8 Nov.; **Leslie B. Seely**, 77, instructor in physics at Pennsylvania State College of Optometry, Philadelphia, 6, Nov.

Orpha M. Thomas, 48, former associate professor of home economics at Teachers College, Columbia University, New York, 6 Nov.; **Lewis R. Thompson**, 71, former assistant surgeon general of the U.S. Public Health Service, scientific director of the Rockefeller Foundation's international health division, and retired director of the National Institutes of Health, Bethesda, Md., 12 Nov.; **Timothy Leary**, 84, investigator in malaria and yellow fever and professor emeritus of pathology at Tufts Medical School, Medford, Mass., 16 Nov.; **A. Hyatt Verrill**, 83, author, naturalist, and explorer, Chiefland, Fla., 14 Nov.; **Harold Weintraub**, 31, assistant professor of mathematics at Tufts College, Medford, Mass., 7 Nov.; **John B. Whitehead**, 82, pioneer in electrical research, electronics investigator, former president of the American Institute of Electrical Engineers, professor emeritus of electrical engineering and a founder and former dean of the School of Engineering at Johns Hopkins University, Baltimore, 16 Nov.; **Robert B. Wolf**, 77, engineer, author, and former director of the National Bureau of Economic Research, New Canaan, Conn., 11 Nov.

Meetings

The department of mechanical engineering of the Technological Institute, Northwestern University, has announced the first in a series of symposiums to be conducted under the leadership of the institute's research group in gas dynamics. The theme of the 1955 **Gas Dynamics Symposium**, which is scheduled for 22-24 Aug. 1955, will be *Aerothermochemistry*. The field is so broad, however, that in this conference emphasis will be placed on problems concerned with combustion instability, turbulent combustion, and the modern aspects of laminar flame propagation. Scientific papers, either of an analytic or of an experimental nature, are now being invited for consideration. It is planned to publish all the papers and their discussions in a volume of proceedings that will appear shortly after the completion of the symposium.

Prospective authors are asked to send abstracts of their research papers giving in approximately 300 words a summary of the material they wish to present. *These abstracts should be in the hands of the symposium committee by 31 Dec.* Authors will be informed of

tentative acceptance by mid-January 1955, and complete papers should be submitted by 15 June 1955. Abstracts and correspondence concerning the symposium should be sent to the Gas Dynamics Symposium, Department of Mechanical Engineering, Northwestern Technological Institute, Evanston, Ill.

On 29 Dec. during the AAAS annual meetings in Berkeley, Calif., a 3-D color motion picture with sound, called "A third dimension for oil," will be presented as part of the symposium *Earth Sciences from the Air, Part II* that is to take place in a joint session of Section E-Geology and Geography and the Geological Society of America, cosponsored by the American Geophysical Union. The film will illustrate a paper on the "Status of photo interpretation in petroleum geology" by Robert L. Anderson of Geophoto Services, Denver, Colo. It presents geologic interpretation of air photographs so that for the first time it is possible to see in a movie what a photogeologist sees as he looks through a stereoscope. The film shows many different examples of stratigraphic and structural types.

A joint meeting of archeologists and classical scholars will be held in Boston 28-30 Dec. to celebrate the 75th anniversary of the **Archeological Institute of America**, founded in Boston in 1879. This meeting of the Institute and the American Philological Association will have George M. A. Hanfmann and Cedric H. Whitman of Harvard University as cochairmen of the local committee. Sessions of the meeting, at which recent archeological discoveries will be discussed, will take place at both the Sheraton Plaza Hotel and Harvard University. Nathan M. Pusey, president of the university, will deliver a welcoming address.

Several distinguished authorities will take part in a discussion on the deciphering of ancient Greek writing of 1400 B.C. In a symposium open to the public Rhys Carpenter of Bryn Mawr College, Carl Roebuck of Northwestern University, James A. Notopoulos of Trinity College, Emmett L. Bennett of Yale University and Carl Blegen of the University of Cincinnati will discuss the achievement in the field and its impact on our knowledge of Homer and early Greece.

In addition to reports on recent excavations, a showing of outstanding archeological films has been arranged. William Chapman's views of the prehistoric cave paintings at Lascaux, France, Ray Garner's short film on the cliff dwellings of ancient Indians in Arizona, and the latter's feature film on Egypt will be shown.

The National Science Foundation will award individual grants to defray partial travel expenses for a limited number of scientists who will attend the **International Union and Congress of Pure and Applied Chemistry**, to be held in Zurich, Switzerland, 21-27 July 1955. Application blanks may be obtained from the National Science Foundation, Washington 25, D.C. Completed forms must be submitted by 1 Feb. 1955.

The council of the **Oak Ridge Institute of Nuclear Studies** held its annual meeting in Oak Ridge on 19 Oct. 1954. The council, consisting of one representative from each of the institute's 32 sponsoring universities, reviewed the year's activities and discussed the future course of development of the institute. Five members were elected to the board of directors, which manages the institute's affairs. They are Paul M. Gross, vice president of Duke University and president of the institute; George L. Cross, president of the University of Oklahoma; George T. Harrell, dean of the School of Medicine, University of Florida; Edward Mack, chairman of the department of chemistry, Ohio State University; and J. Harris Purks, Jr., provost of the University of North Carolina.

Retiring members of the board of directors are Jesse W. Beams, professor of physics, University of Virginia, and William V. Houston, president of Rice Institute. Under a system set up by the council last year, the board is being expanded to 15 members by adding two members yearly through 1955.

T. W. Bonner, professor of physics at Rice Institute, was elected vice chairman of the council. George H. Boyd, dean of the Graduate School of the University of Georgia, is the council chairman. At a meeting of the board of directors following the council meeting, Dr. Gross was reelected president of the institute and Clifford K. Beek, professor of physics at North Carolina State College, was reelected vice president.

Seventeen nations sent representatives to London 4-8 Oct. for a conference on the support of medical research. The meeting was sponsored by the **Council for International Organizations of Medical Sciences**. Members of the U.S. delegation were Ernest M. Allen, chief, Division of Research Grants, National Institutes of Health; R. Keith Cannan, National Research Council; H. Burr Steinbach, National Science Foundation; and R. F. Loeb, Columbia University. In a report on the meeting that has been submitted to NSF, which financed American participation, Allen observes that agreement was reached by the conferees on these principles: (i) The most favorable environment for research is the university; central or independent research institutes should never be established at the expense of university programs. (ii) To make rigid compartments of "basic," "preclinical," and "clinical" research is unrealistic and harmful. (iii) Research support for nonteaching hospitals is justified provided they maintain a high standard of work. (iv) The investigator should work untrammelled, with freedom to alter course and without an obligation to make reports at too-frequent intervals.

In addition, the conference looked with favor upon part-time research fellowships for medical students and also recommended the establishment of a central research body to serve as a clearinghouse for medical research, to set biological and reference standards, to determine neglected areas requiring particular attention, and to perform other functions.

Education

St. Francis Hospital of Ohio State University, the oldest combined medical college-hospital building in continuous operation in the United States, will close in June 1955. Constructed during the years 1849-1851, it has served as an integral component of the College of Medicine for the training of upper class medical students and interns. Originally occupied by the Starling Medical College, forerunner of the present college, the venerable institution is succumbing to the combined factors of rising costs, restricted location, and the burden of its charity work.

Four broad movements of revolutionary magnitude have substantially altered the basic framework of engineering education during the last 25 yr, according to an article in the November issue of *Mechanical Engineering* by Arthur Bronwell, secretary of the American Society for Engineering Education and professor of electrical engineering at Northwestern University. These changes are (i) a substantial strengthening of the mathematics and basic sciences underlying engineering education; (ii) a response to the rapid development of new areas of technology with large-scale commercial application; (iii) increased emphasis upon the development of a balanced educational program; and (iv) a substantial reduction of the time devoted to the teaching of practical skills and techniques.

Bronwell tries to outline the conflicting views that exist among engineering educators on the best methods of coping with the new fields of science in the engineering curriculums, and in conclusion he discusses the difference between acquisition and mastery of knowledge; the intellectual development of engineering students; and the problems of teaching creative thinking to young engineers and of developing leadership qualities in them.

The Institute of Statistics at North Carolina State College is sponsoring a 9-day intensive training program in statistical methods for research workers in industry and the physical sciences starting 22 Jan. 1955 and running daily (including Sundays) through 30 Jan. 1955. The course is designed to make available to research workers in industry and the physical sciences the new statistical techniques of data analysis and experimental design. Guest lecturers will include W. J. Youden, Statistical Engineering Laboratory, National Bureau of Standards; Carl A. Bennett, Hanford Works, General Electric Co.; and Cuthbert Daniel, Statistical Consultant, New York. A registration fee of \$100 will be charged and enrollment will be limited to the first 50 qualified applicants. For further information write to the Institute of Statistics, North Carolina State College, Box 5457, Raleigh.

The School of Dentistry of St. Louis University announces the introduction of a new graduate course, "Conservation of the human dentition," under the direction of Victor H. Dietz.

Available Grants and Fellowships

Grants from the Permanent Science Fund of the American Academy of Arts and Sciences are made in support of research in any field of science whatsoever in amounts normally not exceeding \$1500. Applications for grants to be made next March should be filed by 1 Feb. on forms available from the Chairman, Permanent Science Fund Committee, American Academy of Arts and Sciences, 28 Newbury St., Boston 16, Mass. Special consideration will be given to projects on new frontiers of science, those which lie between or include two or more of the classical fields, those proposed by investigators who may be on the threshold of investigational careers or who are handicapped by inadequate resources and facilities. The committee does not ordinarily approve grants for research the results of which constitute partial fulfillment of requirements for an academic degree.

Special medical research equipment has been placed in the department of medicine of the Tulane University Medical School in memory of the late John E. Monroe, former traffic manager of Pan-Am Southern Corp. The equipment, a large centrifuge and a special microscope, is valued at nearly \$2000. It was purchased with money in the John E. Monroe Memorial Fund, which was contributed by 216 friends and associates of the late Mr. Monroe. Both the centrifuge and the microscope will be used in the study of biological fluids of man.

The Institute of Industrial Health of the University of Cincinnati will accept applications for a limited number of fellowships offered to qualified candidates who wish to pursue a graduate course of instruction in preparation for the practice of industrial medicine. Any registered physician who is a graduate of a Class A medical school and who has completed satisfactorily at least 2 yr of training in a hospital accredited by the American Medical Association may apply. Experience in private practice or service in the Armed Forces may be substituted for 1 yr of training.

The course of instruction consists of a 2-yr period of intensive training in industrial medicine, followed by 1 yr of practical experience in industry. Candidates who satisfactorily complete the course will be awarded the degree of Doctor of Science in Industrial Medicine.

During the first 2 yr stipends vary, in accordance with the marital status of the individual from \$3000 to \$3600 in the first year and \$3400 to \$4000 in the second year. In the third year the candidate will be compensated for his service by the industry in which he is completing his training.

A 1-yr course, without stipend, is also offered to qualified applicants. Requests for additional information should be addressed to the Institute of Industrial Health, College of Medicine, Eden and Bethesda, Cincinnati 19, Ohio.

Books Reviewed in

THE SCIENTIFIC MONTHLY

December

- Name Reactions in Organic Chemistry*, Alexander R. Surrey (Academic Press). Reviewed by T. S. Gardner.
- Aerodynamics*, Theodore von Kármán (Cornell Univ. Press). Reviewed by M. U. Clauser.
- The Power of Words*, Stuart Chase and Marian Tyler Chase (Harcourt, Brace). Reviewed by W. Johnson.
- Vegetable and Flower Seed Production*, Leslie R. Hawthorn and Leonard H. Pollard (Blakiston). Reviewed by G. H. M. Lawrence.
- New Green World*, Josephine Herbst (Hastings House). Reviewed by J. M. Winter.
- Pioneer Plant Geography*, Joseph Dalton Hooker. Vol. 4, *Lotsya: a Biological Miscellany*, W. B. Turrill, compiler; Frans Verdoorn, Ed. (Martinus Nijhoff; Chronica Botanica). Reviewed by J. W. Hedgpeth.
- Annual Review of Medicine*, vol. 5, Windsor C. Cutting, Henry W. Newman, Eds. (Annual Reviews). Reviewed by J. T. Velardo.
- Mammalian Germ Cells*, G. E. W. Wolstenholme, Ed. (Little, Brown). Reviewed by C. Hartman.
- Methods of Theoretical Physics*, pts. I and II, Philip M. Morse and Herman Feshbach (McGraw-Hill). Reviewed by G. Shortley.
- Transactions and Proceedings of the Fiji Society*, vols. 2-4, Fiji Society. Reviewed by A. C. Smith.
- A Bibliography of the Research in Tissue Culture: 1884 to 1950*, vols. I and II, Margaret R. Murray and Gertrude Kopech (Academic Press). Reviewed by R. C. MacCardle.

New Books

- Archaeopteryx lithographica*. A study based upon the British Museum specimen. Gavin de Beer. British Museum (Natural History), London, 1954. 68 pp. £2.
- Macroscopic Theory of Superfluid Helium*, vol. II of *Superfluids*, Fritz London. Wiley, New York; Chapman & Hall, London, 1954. 217 pp. \$8.
- Table of Sine and Cosine Integrals for Arguments from 10 to 100*. Applied Mathematics ser. 32. Reissue of Mathematical Table 13 (1942). National Bur. of Standards, 1954 (Order from Supt. of Documents, GPO, Washington, 25). 187 pp. \$2.25.
- Higher Algebra*, vols. I and II. Helmut Hasse. Trans. by Theodore J. Benac from rev. German ed. 3. Ungar, New York, 1954. 336 pp. \$6.50.
- Exercises to Higher Algebra*. Helmut Hasse and Walter Klobe. Trans. by Theodore J. Benac from rev. German ed. 2. Ungar, New York, 1954. 212 pp. \$4.
- Introduction to the Theory of Neutron Diffusion*, vol. 1. K. M. Case, F. de Hoffmann, G. Placzek. Los Alamos Scientific Lab., Los Alamos, N.M., 1953 (Order from Supt. of Documents, GPO, Washington 25). 174 pp. Paper, \$1.25.
- A Budget of Paradoxes*, vols. I and II. Augustus de Morgan. Dover, New York, ed. 2, 1954. Unabridged republication of ed. 2 (1915). 789 pp. \$4.95.
- Solvents Manual*. With solubility chart. C. Marsden, Ed. Cleaver-Hume, London; Elsevier, Houston-New York, 1954. 429 pp. \$12.95.

- The Behavior and Social Life of Honeybees*, C. R. Ribbands (Bee Research Assoc.; Hale Pub.). Reviewed by MacCardle.
- The Monkey Book*, Ernest P. Walker (Macmillan). Reviewed by P. L. Errington.
- American Seashells*, R. Tucker Abbott (Van Nostrand). Reviewed by J. W. Hedgpeth.
- Animal Control in Field, Farm, and Forest*, W. Robert Eadie (Macmillan). Reviewed by A. S. Leopold.
- Avian Physiology*, Paul D. Sturkie, (Comstock; Cornell Univ. Press). Reviewed by D. R. Griffin.
- The Trees and Shrubs of the Southwestern Deserts*, Lyman Benson and Robert A. Darrow (Univ. of Arizona Press; Univ. of New Mexico Press, ed. 2). Reviewed by E. Anderson.
- Lower Tertiary Foraminifera of the Qatar Peninsula*, Alan Hilder Smout (British Museum, Natural History). Reviewed by J. J. Galloway.
- Plant Growth Substances*, L. J. Audus (Interscience). Reviewed by W. P. Jacobs.
- In Quest of New Ethics*, Charles Mayer (Beacon Press). Reviewed by J. H. Hildebrand.
- Field Crop Production*, Harold K. Wilson and Will M. Myers (Lippincott). Reviewed by W. A. Albrecht.
- A Philosophical Study of the Human Mind*, Joseph Barrell (Philosophical Library). Reviewed by D. Bidney.
- Essays in Sociological Theory*, Talcott Parsons (Free Press, rev. ed.). Reviewed by H. Alpert.
- Biological Effects of External X- and Gamma Radiation*, pt. I, Raymond E. Zirkle, Ed. (McGraw-Hill). Reviewed by C. A. Tobias.
- Method and Perspective in Anthropology*, Robert F. Spencer, Ed. (Univ. of Minnesota Press). Reviewed by E. H. Ackerknecht.
- 1954 Medical Progress*, Morris Fishbein, Ed. (Blakiston). Reviewed by G. W. Anderson.

- Nuclear Species*. H. E. Huntley. Macmillan, London; St. Martin's, New York, 1954. 193 pp. \$4.50.
- The Use of Stereographic Projection in Structural Geology*. F. C. Phillips. Edward Arnold, London, 1954 (Distributed by St. Martin's, New York 17). 86 pp. \$3.
- The Neuroanatomical Basis for Clinical Neurology*. Talmage L. Peele. McGraw-Hill, New York-London, 1954. 564 pp. \$12.50.

Miscellaneous Publications

- This is Educational Television*. Natl. Citizens Committee for Educational Television, Washington 6, 1954. 16 pp.
- Carboniferous Flora of Peru*. Bull., Geology, vol. 2, No. 5. Wilhelmus Josephus Jongmans. British Museum (Natural History), London, 1954. 35 pp. + plates. 15s.
- The Colon: Its Normal and Abnormal Physiology and Therapeutics*. Annals, vol. 58, art. 4. Roy Waldo Miner, Ed. New York Acad. of Sciences, New York 21, 1954. 248 pp. Illus.
- Bibliographical Bulletin of American Anthropology*, vols. 15 and 16, 1952-1953, pt. 2 (In English, French, and Spanish). Instituto Panamericano de Geografía e Historia, Tacubaya, D.F., Mexico, 1954. 373 pp. \$4 per vol.
- Spectrographic Studies of the Combination Variables Z Andromedae, BF Cygni, and CI Cygni*, vol. 2, No. 11. L. H. Aller. Dominion Astrophysical Observatory, Victoria, B.C., 1954. 41 pp. Illus. 25¢.

Technical Papers

Prevention of Alloxan Diabetes by Sodium Nitrite and Paraminopropiophenone

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The injection of alloxan into laboratory animals causes a rapid decline in the glutathione content of the blood (1). Excess of glutathione, injected intravenously just before alloxan is given, prevents alloxan diabetes (2). This and other evidence, summarized by Houssay (3), suggest that the level of sulfhydryl in blood is an important factor in the etiology of alloxan diabetes. Recently it was found that sodium nitrite and paraminopropiophenone (PAPP) increased blood sulfhydryl as much as 50 percent in rats and guinea pigs when given in doses producing substantial methemoglobinemia (4). This led to experiments, described here (5), to determine the effects of nitrite and PAPP upon alloxan diabetes.

Male Long-Evans rats weighing 130 to 160 g were injected subcutaneously with the methemoglobin-formers and intraperitoneally, $\frac{1}{2}$ hr later, with alloxan. In the first experiment they received 4 mg of sodium nitrite in 0.1 ml of phosphate buffer (pH 7.2), or buffer alone, and then alloxan at 250 mg/kg. In the second experiment they received 3 mg of PAPP in slightly acidified saline, or acidified saline alone, and alloxan at 250 mg/kg; and additional treatment 2 days later with 2 mg of PAPP and 100 mg/kg of alloxan. The animals were kept in individual metabolism cages with water and their usual food (6) until the end of the experiments. Sugar determinations (7) were made on urine samples on the 5th and 11th days after alloxan and on blood the 12th day. An animal was counted as diabetic if it showed blood sugar in excess of 180 mg/100 ml (8) on the 12th day and at least one previous urinary sugar measurement exceeding 1 g per 20 hr. (Actually only one "diabetic" in each experiment had blood sugar below 300 mg/100 ml or less than the two possible high urinary sugar values). Table 1 summarizes the results.

Table 1. Diabetes and mortality after alloxan, in rats pretreated with nitrite or paraminopropiophenone.

Rats	Number	Dead	Diabetic	Non-diabetic
Nitrite-treated	20	1	1	18
Controls	20	7	8	5
<i>P</i> ^a		0.05	< 0.01	
PAPP-treated	20	1	1	18
Controls	24	5	10	9
<i>P</i> ^a		> 0.20	< 0.01	

^a Based on χ^2 , Goulden's corrected formula (9).

Under the conditions of the experiments, the doses of alloxan used approximated the LD₅₀ and the ED₅₀ for diabetes. It is clear that both nitrite and PAPP gave marked protection against the effects of alloxan, whether these were manifested by deaths (presumably due to hepatorenal damage) or by diabetes (damage to the pancreatic islets). Both experiments therefore were consistent with the hypothesis that suggested them—that is, that the determining factor in prevention of this type of diabetes is the level of blood sulfhydryl at the time alloxan is injected. This implies chemical reaction between the alloxan and blood sulfhydryl. The sulfhydryl is largely intraerythrocytic, and the alloxan remains in the blood only for a few minutes (1); therefore this reaction should be investigated by diffusion techniques. Until such a reaction is clearly demonstrated to be possible, it would be well to reserve judgment concerning the mechanism(s) by which these two methemoglobin-formers prevent alloxan diabetes.

References and Notes

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8. This "upper limit of normality" [E. H. Kass and B. A. Waisbren, *Proc. Soc. Exptl. Biol. Med.* **60**, 303 (1945)] is in agreement with our data for untreated rats. Urinary sugar of normal, untreated rats on regular diet is usually below 20 mg/day.
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20 July 1954.

Factors Necessary for the Growth of *Bacteroides succinogenes* in the Volatile Acid Fraction of Rumen Fluid

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Bacteroides succinogenes has been shown to be one of the more important of the cellulolytic bacteria that are essential to normal digestion in the bovine rumen (1-3). This organism is one of several kinds of rumen bacteria that have not been grown without rumen fluid in the medium.

The factor(s) required by *B. succinogenes* was not detectable in several materials commonly used to grow nutritionally fastidious bacteria or in extracts from

alfalfa meal or bovine feces (2). It was shown to be stable to heat, acid, alkali, and drying and was not a known B vitamin, amino acid, peptide, purine, pyrimidine, oleic acid, or mineral, although some of these substances are undoubtedly also required. Hungate (3) concluded that the factors required for growth of this organism are not all present in the feed consumed by the animal but are in part produced by the accompanying microorganisms. The purpose of the present work was to determine the nature of this unknown factor.

The assay procedure involved the use of an anaerobic culture method previously described (1). The basal culture medium contained minerals, B vitamins, purines, pyrimidines, casein hydrolyzate (enzymatic), a carbonic acid-bicarbonate buffer system, and either glucose or cellulose (0.3 percent Whatman No. 1 filter paper) as carbon source. Growth in mediums containing cellulose was estimated by the visible loss of cellulose from the tube and growth in glucose mediums was estimated by amount of turbidity after about 18 to 20 hr of incubation using the Cenco-Sheard Spectrophotometer set at 420 m μ .

The factor was found in the ether extract of rumen fluid extracted at pH 2 but not in the residue. The reverse was true on ether extraction at pH 10. The factor was found in the volatile acid fraction on acid steam distillation and was not volatile when distilled under alkaline conditions. Fractionation of the volatile acids by chromatographic technique (4) showed most of the activity to be present in the valeric acid fraction.

The assay of commercially available volatile fatty acids showed that none of the acids, C₂ through C₈ and their isomers, n-heptanoic, or n-caprylic, allowed a significant amount of growth when added singly to the basal medium. However, when all combinations of two of the acids isobutyric, n-valeric, isovaleric, DL- α -methyl-n-butyric, or n-caproic were assayed, good growth occurred if one was a straight-chain acid and the other, a branched-chain acid. This observation was confirmed by assaying all possible combinations of three of these acids. In this case the only combination not allowing growth was that containing the three branched-chain acids.

Studies to date show that the branched-chain component can be any one of the acids isobutyric, isovaleric, or DL- α -methyl-n-butyric. Isocaproic, trimethyl acetic, or the straight-chain acids C₂ to C₈ will not replace these acids. The straight-chain component can be any one of the acids C₂ to C₈. Acetic, propionic, n-butyric, or lauric acid will not replace these acids. A small amount of activity for the straight-chain component was found in palmitic and stearic acid.

Minimum concentrations for good growth when n-valeric and isovaleric acids were used were about 3 and 1.5 μ M, respectively, per 10 ml of medium.

It seems probable that the acids chiefly concerned with the growth response due to rumen fluid are isobutyric, isovaleric, and DL- α -methyl-n-butyric acid for the branched-chain component, and n-valeric and

n-caproic acid for the straight-chain component. These have all been found in significant amounts in rumen fluid (5, 6). The probable origin of these acids by Stickland reactions from amino acids has been discussed by El-Shazly (7).

Details of this work will be reported elsewhere.

Note added in proof: After this work was submitted for publication, O. G. Bentley *et al.* reported that the volatile fatty acids, n-valeric, isovaleric, isobutyric, and n-caproic, or their amino acid precursors stimulated cellulose digestion and the conversion of urea nitrogen into protein by rumen microorganisms as measured by the "artificial rumen" technique (8).

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30 July 1954.

In vitro Differentiation between Auto- and Isoimmune Antibodies by Protamine and Trypsin

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It has been shown that low concentrations of heparin inhibit the agglutination of red cells coated with auto-antibodies (1). This phenomenon was believed to be either competitive, similar to the mechanism of hemagglutinating virus antagonists (2), or due to the strongly negative charge of heparin. Although auto-antibodies were selectively inhibited, no interaction with isoantibodies was observed (contrary to virus antagonists). The effect of a positively charged colloid on these hemagglutinins was therefore investigated (3). Protamine sulfate (Lilly) in concentrations from 0.01 percent (pH 6.11) to 1.0 percent (pH 5.98) was used.

It was found that saline suspensions of normal cells, cells sensitized with anti-D (albumin) typing serum (4), and cells from patients with idiopathic acquired hemolytic anemia were agglutinated by protamine sulfate. Normal, trypsinized cells (5) were not affected by any of the concentrations used. Control series showed that acidification alone (6) will not cause agglutination in the absence of protamine, nor will neutralization of a protamine solution (pH 7.1) affect its agglutinating ability. The effect of cell fragility was also negated, since the resistance to hypotonic saline was the same before and after trypsinization. The possibility of protamine inactivation by minute amounts of trypsin adsorbed on the cell surfaces (7)

is unlikely. Such traces, if present, would exhibit tryptic activity also upon incubation with unprocessed x-ray film. Control experiments showed that this was not the case.

In an attempt to prevent the agglutination by protamine, red cells were suspended in 0.5 to 2.0 percent saline dilutions of bovine albumin. Differences were observed between the dilutions necessary to protect normal cells, cells sensitized with anti-D antibody, or coated with autoantibodies (patients' cells). Similar results were noted with saline suspensions of cells exposed to varying concentrations of protamine sulfate. The critical values varied with cells from different individuals. However, normal cells were always the most resistant, and Rh-sensitized cells were the most susceptible to agglutination (Table 1).

Table 1. Effect of mixtures in promoting (+) or inhibiting (-) the agglutination of test cells. Red blood cell suspensions, 2 percent. Volume of reactants, 0.1 ml each. Titer of direct Coombs' test on patients' cells and sensitized cells, 1:256. Cell suspensions incubated with the mixtures for 10 min at 37°C and subsequently centrifuged for 1 min at 1000 rev/min.

Agglutinating medium	Normal cells	Patients' cells (auto-antibodies)	Sensitized cells (isoantibodies)	Trypsinized cells
Protamine 1%				
Saline	+++	+++	+++	-
Protamine 0.08%				
Saline	-	+	+++	-
Protamine 1%				
Albumin 2%	-	-	+++	-
Protamine 1%				
Albumin 0.5%	-	++	+++	-
Protamine 1%				
Trypsin 1%	-	-	+++	-
As above, pre-incubated 10 min	-	-	+++	-
Trypsin 1%				
Saline	-	-	+++	-
Saline alone				
(Control No. 1)	-	-	-	-
2% albumin alone				
(Control No. 2)	-	-	-	-

When trypsin and protamine were added simultaneously to the cell suspensions, only cells coated with anti-D antibody agglutinated. Incubation of protamine and trypsin for 10 min prior to their addition to these cell suspensions had the same effect. Since trypsin digests protamine, it became apparent that the enzyme itself must function as the agglutinating agent. Tests performed with trypsin alone confirmed its selective ability to agglutinate cells coated with anti-D antibodies (Table 1).

This effect is independent of the concentration of trypsin from 0.05 to 1.0 percent but requires incuba-

tion and seems to diminish with decreasing direct Coombs' titers.

These observations substantiate the reported differences between auto- and isoimmune antibodies (1). The trypsin effect also suggests a connection between two seemingly unrelated phenomena: (i) trypsinized cells are more susceptible than normal cells to agglutination by gamma globulin (8); (ii) the isoantibodies in hemolytic anemia of the newborn are gamma globulins, whereas the autoantibodies in acquired hemolytic anemia, are not (9).

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4. 5.0 ml of a 2-percent O/CDE cell suspension in saline incubated for 30 min with 0.015 ml of anti-D (albumin) typing serum gave a direct Coombs' test titer of 1:256.
5. 1-percent saline solution of "Difco 1:250" trypsin plus 1/10 its volume phosphate buffer pH 7.1; filtered before use. Trypsinization of cells was achieved by incubating a normal cell suspension with 1/10 volume enzyme mixture for 10 min.
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On the Sources of Soil Phosphorus Absorbed by Mycorrhizal Pines

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Previous studies have indicated limited absorption of phosphorus by nonmycorrhizal pines in certain soils (1, 2). Either successful mycorrhizal inoculation or heavy applications of inorganic phosphates were effective in overcoming acute phosphorus deficiency (2). The mode of action of the mycorrhizal association is unknown. Among hypotheses are the possibility that activity of the extensive mycelium ramifying from the root tips might release phosphorus from the soil organic matter in the immediate vicinity of unabsorbed root tips (1, 3) or the phosphorus might be transmitted to the root through fungal hyphae (4). Release into the soil solution remote from the root tips is unlikely, since benefit to pine was not shared by a companion grass (2).

Distinction between soil inorganic and organic phosphorus forms is possible. When inorganic P³² is added to the soil, it rapidly undergoes dilution and isotopic exchange with the inorganic soil phosphorus in accessible sites (5). Phosphorus in organic forms, being held by covalent bonds, remains unlabeled except as P³² is gradually incorporated by microbial synthesis (6). Accordingly, in a soil so treated, a plant able to utilize organic forms would be characterized by a

phosphorus content of lower specific activity than one absorbing entirely from inorganic sources.

This possibility was tested, employing two prairie soils naturally lacking mycorrhizal fungi: A Carrington silt loam from Wisconsin contained 5.3 percent organic matter and 6 and 36 lb inorganic P per acre, respectively, as determined by Peech's (7) and Bray's (8) methods. Comparable values for an O'Neill sandy loam from Iowa were 2.8 percent, and 1 and 22 lb. Phosphorus as $\text{KH}_2\text{P}^{32}\text{O}_4$ (9) was added at rates of 10 and 100 lb P per acre. For uniform distribution, solutions of radiophosphorus were sprayed upon the air-dried soil as it tumbled in a rotating drum; 1000 g of the Carrington soil or 930 g of the O'Neill soil were placed in 1-qt pots.

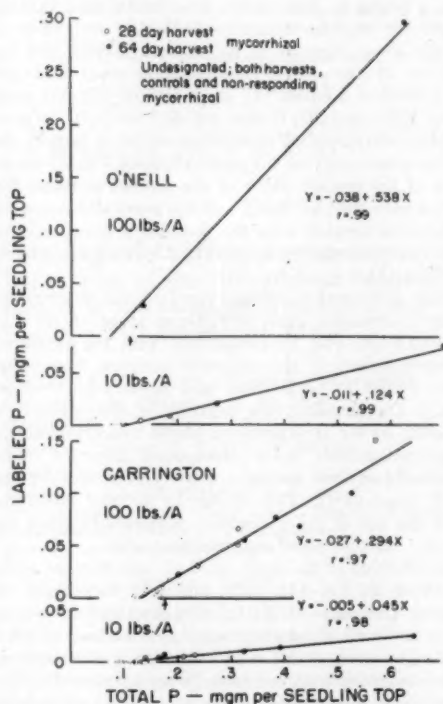


Fig. 1. Uptake of labeled phosphorus as related to increased total phosphorus in the tops of Monterey pine seedlings. Arrows mark average content at time of transfer.

Two seedlings that had been grown for 7 wk in 0.1 Hoagland's solution lacking phosphorus were transplanted to each container. Those transferred to the Carrington and O'Neill soils had mean dry weights of 0.23 and 0.16 g, respectively, and an average phosphorus content of 0.086 percent, an amount slightly less than the initial seed content. Segments of mycorrhizal pine root were used as inoculum, and the controls received similar segments autoclaved. A week later Italian rye grass was sown into designated treat-

Table 1. Percentage of total phosphorus in the tops of grass and mycorrhizal pines derived from labeled inorganic phosphorus added to soil.

Soil and rate of addition (lb/acre)	Rye grass (%)	Monterey pine	
		Regression coeff. Fig. 1 (%)	Mean of individual estimates* (%)
Carrington, 10	5.5 ± .1	4.5	5.6 ± .6
Carrington, 100	40.1 ± .2	29.4	35.0 ± 2.9
O'Neill, 10	14.7 ± .5	12.4	12.5 ± 1.0
O'Neill, 100	64.8 ± .6	53.8	63.0 ± 7.

* Including only those containing, in the 100 lb/acre series, more than 0.020 mg labeled P, or, in the 10 lb/acre series, more than 0.002 mg.

ments with and without pines. The grass and one-half of the pine treatments were harvested after 28 days, and the remainder of the pine after 64 days. Only the tops were analyzed for total phosphorus (10) and radiophosphorus (11).

Slow and irregular response of the inoculated seedlings, apparently resulting from the initial deficiency, destroyed the original statistical design. All seedlings evidencing appreciable increases in dry weight or phosphorus content were mycorrhizal, however, whereas none of the nonmycorrhizal controls responded. Inoculated seedlings with few or recently formed mycorrhizae at harvest likewise showed little or no response. Although the tops of the nonmycorrhizal and nonresponding seedlings increased slightly in dry weight, they decreased in phosphorus content. This apparent loss was presumably due chiefly to transfer into the roots. Despite this reduction in total phosphorus, at the 100-lb rate 4.8 and 11.3 percent of the phosphorus in the tops from the Carrington and O'Neill soils, respectively, was derived from the added phosphate. These observations are in accord with the finding of Kramer and Wilbur (12) that nonmycorrhizal pine roots do accumulate phosphorus from solution but to a lesser extent than mycorrhizal roots.

As is shown by Fig. 1, the increased total phosphorus associated with mycorrhizal formation is linearly related to uptake from the inorganic addition. The relationship is affected by soil and rate of addition, but not by duration or extent of mycorrhizal activity as reflected in total phosphorus content. The constancy of the relationship is noteworthy only in that it corresponds precisely with the expected behavior of the common horticultural species.

One may also compare the ratio between added and native soil phosphorus in the totals absorbed by the mycorrhizal pines and by rye grass in comparable cultures. Allowance must be made for the initial phosphorus content of the pine, either (i) through use of the regression coefficients of Fig. 1, or (ii) by deducting the mean content of nonresponding plants at harvest from the individual values for responding seedlings. Table 1 presents the two estimates for the pine

seedlings compared with the values for the grass at the end of the 28-day period.

Both pine seedling estimates are weighted by data from the 64-day harvest, in contrast to the 28-day harvest of the grass. Microbial synthesis and possibly chemical exchange as well would have continued through the intervening period, gradually reducing the specific activity of phosphorus available from inorganic forms. The slopes of the regressions are further diminished by the lowered phosphorus content of non-responding plants. Allowance for these factors indicates fair agreement between the respective values for pine and grass.

Thus it appears that in each of the four combinations of soil and fertilizer, Italian rye grass and mycorrhizal pine seedlings utilized the added inorganic phosphorus and native sources to a very similar degree. It may be concluded that the mycorrhizal roots possessed no exceptional facility for utilizing phosphorus from the soil organic matter.

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Separation of *dl-cis* from *dl-trans* Labeled and Unlabeled Chrysanthemic Acids on Paper

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Carbon-14 labeled *dl-cis,trans*-allethrin has been synthesized (1), and its physiological and insecticidal behavior in houseflies and cockroaches is now being investigated (2). Obviously, the value of this investigation would be greatly increased by the comparison of the eight isomeric labeled allethrins with one another.

The unlabeled compounds have been prepared from the isomeric chrysanthemic acids and allethelones

following their resolution by standard chemical techniques (3). Because only 2 g of the *dl-cis,trans*-2 C¹⁴ chrysanthemic acid was available to us, other methods of separation were required, and a method applicable to microgram quantities was very desirable. The first step toward such a procedure has been accomplished by the successful separation on paper of the *dl-cis* from the *dl-trans* chrysanthemic acid.

The solvent was prepared by shaking 50 parts of isopropyl acetate with 25 parts of 10-percent aqueous ammonium hydroxide. The mixture was then allowed to stand in the chromatographic chamber overnight for separation and for saturation of the atmosphere. Saturation was facilitated by hanging wide paper strips in both layers of the solvent mixture. Whatman No. 1 paper in 1-in. strips was drawn once through 1-percent aqueous ammonium chloride and air-dried in the hood. Five to 20 µg of both labeled and unlabeled *dl-cis,trans*-chrysanthemic acids and also of authentic samples (4) of *dl-cis* and *dl-trans* acids (mp 115° to 116° C and mp 51° to 54° C, respectively), were applied to separate strips of paper. The strips were irrigated for approximately 4 hr by ascension of the organic layer of the solvent mixture. The strips were then air-dried, and the zones of ammonium salts were located with the potassium permanganate and benzidine sprays applied as described by Winteringham (5).

The developed chromatograms of the *dl-cis,trans*-chrysanthemic acids had dense zones of Rf 0.37 and 0.60 (6) and, by comparison with the developed chromatograms of the authentic samples, these zones were found to be *dl-trans* and *dl-cis* acids, respectively. On standing, the polarity of the solvent increased, owing apparently to slight hydrolysis of the isopropyl acetate. As a consequence these Rf values gradually shifted during a 2-wk period to 0.51 and 0.72, respectively. This change in no way interfered with the use of the procedure, particularly when authentic samples were run simultaneously.

In addition to the zones of *dl-cis* and *dl-trans* acids, zones of Rf 0.0–0.01, 0.20, and 0.98 have been observed. The zones of Rf 0.0–0.01 and 0.98 have been common to all chromatograms that contained *dl-trans* acid. The zone of Rf 0.20, although visible only in chromatograms obtained from 20-µg samples of *dl-cis,trans* acid, was detected radiometrically in the labeled product. The zone of Rf 0.98 also was obtained on all chromatograms of the *dl-cis* acid, but it occurred to a lesser extent in the authentic samples than in the *dl-cis,trans* acids. Although the zone of Rf 0.98 was detectable on strips run as blanks and was probably due partly to traces of impurities in the solvent, there is no doubt that additional material traveled to this zone when the acids were chromatographed. The presence of materials having these Rf values has also been demonstrated in a commercial sample of *dl-cis,trans*-chrysanthemic acid.

To learn more about the impurities, unsprayed chromatograms from 20-µg samples of labeled acid were sectioned according to sprayed duplicates and

the substances were eluted with 70-percent ethanol containing a few drops of dilute ammonium hydroxide. Radiometric measurements were made on the air-dried residues in comparison with similarly treated but unchromatographed standards. The average counts per minute (in parentheses), corrected for background, from six replications were as follows: standard (124), Rf 0.0-0.01 (8), Rf 0.18-0.20 (13), Rf 0.4-0.5 (48), Rf 0.6-0.7 (31), Rf 0.98 (10), total recovered (110). The origin and the nature of the zones of impurities cannot be explained from the data available at the present time.

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30 September 1954.

Physiological Evidence Concerning Importance of the Amygdaloid Nuclear Region in the Integration of Circulatory Function and Emotion in Man

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Preliminary findings presented in this paper (1) suggest that in man the amygdaloid nuclear complex, situated in the temporal lobe, may play a role in circulatory regulation as well as in emotional expression. The observations were made in five epileptic patients in each of whom a multiple electrode, consisting of four parallel needles, had been implanted in the amygdaloid region of one temporal lobe by a specially modified stereotaxic apparatus. Three of the needles were of equal length and spaced 5 mm apart in the position of an equidistant triangle, while the fourth was 3 mm shorter and was located in the center of this triangle. This electrode was used to record the electric activity, to stimulate this region, and finally to coagulate this nuclear area for therapeutic purposes. The amygdaloid area was localized by measurements derived from skull x-rays of the clinoids in each patient and from air studies of the tip of the temporal horn in all except one case.

Preliminary studies with the stereotaxic instrument

in 11 cadavers using the same skull landmarks revealed that our centrally placed electrode needle entered the amygdaloid nuclei in nine cases and missed this structure by 1 mm in two cases. Since we have no tissue specimens in any of our patients for the determination of the precise location of the electrodes, we have defined the area studied as the amygdaloid nuclear region, meaning thereby, the area in or near the amygdaloid nuclei.

Three patients were diagnosed as having epilepsy with assaultive behavior of such severity as to necessitate confinement in a psychiatric institution. Two patients had a diagnosis of psychomotor (temporal lobe) seizures of incapacitating severity. All had electroencephalographic abnormalities in the temporal area before operation. The amygdaloid region was coagulated in the patients with assaultiveness in an attempt to modify favorably this behavior, and in the patients with psychomotor epilepsy, to avoid greater destruction by temporal lobe extirpation, such as is used in some centers in the treatment of that condition. In each case, a group of psychiatrists had recommended surgical treatment after all attempted medical therapy had failed. The extent of the lesion caused by the current parameters used for coagulation had been previously determined in 12 cats. The results of coagulation will not be reported until sufficient time has elapsed for clinical evaluation to be meaningful. Electric stimulation was employed in an attempt to obtain a clearer understanding of the functions of the amygdaloid region, including its role in our patients' illnesses. The effects of electric stimulation of the amygdaloid region on feeling states and the continuous recording of blood pressure and heart rate were studied, and the electric activity from this region and from the scalp was recorded at various intervals during a 7 to 9 day period prior to the therapeutic electric coagulation procedure.

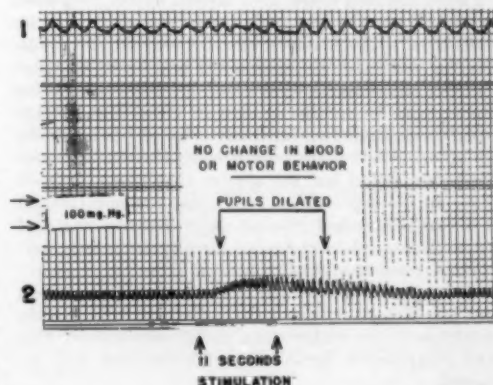


Fig. 1. Electric stimulation caused a 50 mm-Hg rise in systolic and 33 mm-Hg rise in diastolic blood pressure and pupillary dilatation without producing mood or somatic responses. (1) Respiratory tracing. (2) blood pressure tracing; 60 pulses/sec, 1 msec pulse duration, 12 v.

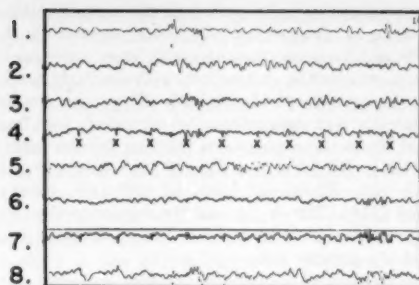
Stimulation with a monophasic square wave at a rate of 20 to 60 pulses/sec, 1 msec pulse duration and 7 to 17 v for periods of 3 to 30 sec produced a variety of responses. In four patients, feelings of fear, anxiety, and at times a "weird" or "terrific" feeling in association with alterations in motor behavior were obtained. When the intensity of the stimulus was slightly increased or maintained for a longer period, the patients would show momentary confusion and unresponsiveness. Ability to count and the performance of a skilled act such as winding a string around a pencil would become impaired. In three patients, bilateral pupillary dilatation and a 20 to 100 percent increase in heart rate were elicited. In two patients, electric stimulation caused a 50 to 80 mm-Hg rise in systolic and a 30 to 60 mm-Hg rise in diastolic blood pressure, and, in one patient, widening of the palpebral fissure. The circulatory and pupillary responses could be obtained independently of, or in association with, alterations in mood, motor behavior, and changes in respiratory rhythm (Fig. 1). The time interval between the beginning of electric stimulation and the changes in the blood pressure or heart rate indicated that some responses were mediated directly by nervous pathways and suggested that others were perhaps mediated by the liberation of a humoral substance. All responses were readily reproducible. Voluntary motor movements simulating those induced by electric stimulation did not elicit the circulatory effects.

In the patients so far tested, stimulation that has not resulted in a psychomotor seizure has frequently been followed by increased muscle tension and eye blinking, which has obscured the electroencephalographic recording. This was found to take place even when the patient reported absence of subjective sensations.

In one patient with a diagnosis of psychomotor epilepsy who was having spontaneous seizure discharges confined to the area tapped by the deep electrodes, the only sign at the scalp electrodes was an occasional spike at the temporal tip on the same side. During these electric seizures the heart rate was augmented, and there was a great increase in blinking movements. In another patient in whom high voltage spikes were occurring randomly at the depth electrode, spikes at the temporal scalp electrodes on the same side were found but not always simultaneously with those in the depth (Fig. 2). Paillas (2) and Gastaut (3) have described similar spike activity recorded from the amygdala in two of their patients with psychomotor seizures.

The only complication known to have arisen from our use of the implanted electrodes was a temporary weakness of the contralateral facial musculature. This had disappeared by the time the electrode was removed.

The finding of striking elevations of blood pressure can now be added to previous studies in animals



I = 50 microvolts X = EKG.

Fig. 2. Simultaneous spiking in amygdaloid region and temporal scalp. Channel 1 shows spikes occurring spontaneously in the left amygdaloid region, picked up by implanted bipolar electrode. Simultaneously, a spike appears at the scalp in the anterior temporal lead on the same side. Recorded on the third day after operation. The crosses indicate heartbeats. Scalp leads are shown as follows: channel 2, left frontal to left anterior temporal; 3, left anterior temporal to left midtemporal; 4, left midtemporal to left posterior temporal; 5, right frontal to right anterior temporal; 6, right anterior temporal to right midtemporal; 7, right midtemporal to right posterior temporal; 8, left anterior temporal to right anterior temporal.

or man of the effects of electric stimulation of the amygdaloid region. Feindel, Penfield, and Jasper have reported (4) that electric stimulation in the region of the claustramygdaloid complex in the awake patient at operation frequently caused features of automatism, which probably included confusion, unresponsiveness, and abnormal motor behavior, as was noted in our patients. Pupillary dilatation, increases in heart rate, and behavior changes have been previously reported in amygdaloid studies in animals (5). Our observations may lend further support to the views expressed by the comparative anatomist that some portions of the amygdaloid complex may constitute a part of the brain concerned with visceral and somatic expression of internal states (6).

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5 August 1954.

Communications

Contemporary Science and the Poets Reconsidered

While I have observed with pleasure the increasing frequency with which scientific journals have been concerned with problems in language and literature, my pleasure is often tempered with annoyance at the scientist's patronizing tone and his misunderstanding of the poet's function. Mrs. Fullmer's recent article (1) is a case in point. Now I do not wish to enter into a discussion of the vexed problem of the values of modern science. But I believe that Mrs. Fullmer's article is a clear case of the inadequacy of the scientific method and perspective as applied to the arts. For example, she sees the poet as a "human kind of barometer . . . to register the impact of each fresh discovery, each major theoretical advance." This notion of the poet as a sensitive instrument recording in fancy language his responses to the stimuli about him is curiously naive and romantic, and it violates the time-honored and much more correct concept of the poet as "maker," as a creator of language Gestalts that embody the feeling-qualities of human experience in a way that ordinary referential language cannot do. As Susanne Langer expresses it (2, p. 40; 385-386):

Art [including poetry] is the creation of forms symbolic of human feeling . . . an art symbol and a scientific symbol . . . are as different as art is from science: it is, indeed, the radical difference between their respective symbolic forms that makes art and discourse (logic, science, matter of fact) fundamentally different realms, and removes the hope (or fear, as the case may be) of some philosophers that in an "age of science" art will aspire and finally graduate to the dignity of scientific thought.

R. P. Blackmur, one of our most distinguished contemporary critics, says (3) that

. . . psychology turns aesthetics into the mechanics of perception, that scientific logic turns it into semiology, just as technical philosophers had already turned it into a branch of epistemology. All these studies are troublemakers and lead . . . to the proliferation of a sequence of insoluble and irrelevant problems so far as the critic of literature is concerned.

Charles W. Morris puts it another way (4):

Since the work of art is an icon and not a statement, aesthetic discourse is not restricted to signs whose truth is confirmable. . . . Art does not, except incidentally, make statements about values, but presents values for direct experience; it is not a language about values, but a language of value.

From the perspective of the poet, critic, and esthetician, then, Mrs. Fullmer is a "troublemaker" when she focuses her attention on an irrelevant aspect of modern poetry, its "scientific content."

Furthermore, the restrictions that Mrs. Fullmer puts on the term *scientific content* are puzzling, to say the least. She explicitly excludes (i) "the concept of the very nature of scientific truth," (ii) "value judgment" of the elements of scientific inquiry, and (iii) "products of applied science." What does she include? "The newer theoretical concepts and broad points of view . . . the scientific spirit, the scientific attitude." Her analysis of excerpts from modern poets reveals that she is not self-consistent in applying her own formulas, and she is often unaware of the real meaning of the passages under consideration. For example, in the first selection quoted from Eliot (the lines that the "scientist finds more striking"), the poet is clearly attacking the religious or metaphysical limitations of science when he urges that the experiments of science bring "knowledge of motion, but not of stillness." *Stillness* here is symbolic of the eternal and spiritual unity of the universe (compare *Murder in the Cathedral*); and if this is not a rejection of "the concept of the very nature of scientific truth," what is? It is to be expected, I suppose, that a practicing scientist should see the second selection from Eliot as a fine, worthy expression of the scientific spirit, but Mrs. Fullmer fails to catch the ironic overtones and the significance of the qualifying "only" in "what is actual is actual only for one time/And only for one place." Waggoner, whom Mrs. Fullmer challenges, is indeed right in observing that Eliot indicts science. I personally do not believe that it is of primary importance to the quality of Eliot's poetry whether he indicts science or not, but if we are going to be concerned with the secondary issues of poetry, let us at least be accurate in getting the full lexical sense of the lines. Mrs. Fullmer's scientific faith is, indeed, intellectually provincial; she is "jarred" by Douglas Bush's observation that the airplane in Eliot's poetry is a "symbol of scientific slaughter . . . for this would mean killing in the spirit of free inquiry. It is doubtful that any poet ever meant *this*." But that is precisely what Eliot means, and Eliot is not unique among modern poets and critics. Kenneth Burke, for example, expresses (5) an attitude widely felt among humanists that:

The very scientific ideals of an "impersonal" terminology can contribute ironically to such a disaster [as the genocide practiced by Hitler's scientists]: for it is but a step from treating inanimate nature as mere "things" to treating animals, and then enemy peoples, as mere things. But they are not mere things, they are persons—and in the systematic denial of what he knows in his heart to be the truth, there is a perverse principle that can generate much anguish.

The excerpts that Mrs. Fullmer quotes from Marianne Moore seem to refer to the third element that Mrs. Fullmer had excluded from consideration, namely, the "products of science": the four vibrators of an exact clock and the quartz prism which measures

temperature change. Moreover, the excerpts as they stand are *not* poetry, despite the fact that the right-hand and left-hand margins are irregular. They are referential statements utterly lacking in the imagery that more than anything else distinguishes the language of poetry from ordinary discursive language. Written in prose form in a pamphlet, they would not be identifiable as poetry by any literary critic worth his salt.

However, to the poet and literary critic, Mrs. Fullmer's underlying assumptions and explicit statements concerning the very nature of poetry are much more disturbing than her treatment of particular selections from modern poets. The fact that poets use references to science (which are transformed in successful poems by the language context in which they are employed, so that they are no longer significant as scientific utterances but as part of a symbolic presentation of human conative-affective experiences) is hardly news; as Cleanth Brooks observes (6), "all poetry since the middle of the seventeenth century has been characterized by the impingement of science on the poet's world." But this is not to say that there is such a thing as a scientific poetry or even a poetry *about* science, for poems are not documents; and the extracting of documentary excerpts is an ignoring—even a destroying—of what Mrs. Langer describes (2, p. 40) as a "virtual experience, wholly formed, and wholly expressive of something more fundamental than any 'modern' problem: human feeling, the nature of human life itself." The creation of such forms of feeling requires mental processes far different from those employed by scientists and teleological aims equally far removed. Mrs. Fuller is simply wrong in asserting that "the thought processes that are successful in transforming scientific techniques are, in some measure, similar to those operating to transform poetic techniques."

It is a puzzle, too, how she can postulate a similarity between poetic and scientific techniques and in the next breath claim that "poetry is a reliable index [of the extent of popularization of major scientific advances] *because it is unself-conscious*." (Italics mine.) Here she is again a victim of romantic notions of the poet's technique; no successful artist, whatever his medium is, simply expresses spontaneously and unself-consciously the intellectual currents in his environment. Rather, as T. E. Hulme brilliantly described it (7),

The process of artistic creation would better be described as a process of discovery and disentanglement. To use the metaphor which one is by now familiar with—the stream of the inner life, and the definite crystallized shapes on the surface—the big artist, the creative artist, the innovator, leaves the level where things are crystallized out into these definite shapes, and, diving down into the inner flux, comes back with a new shape which he endeavors to fix. . . . It is as if the surface of our mind is a sea in a continual state of motion, that there are so many waves on it, their existence is so transient, and they interfere so much with each other, that one is un-

able to perceive them. The artist by making a fixed model of one of these transient waves enable you to isolate it out and perceive it in yourself.

For the poet, then, the ideas of science are nothing more than waves on the surface of the sea of his mind; his significant act is the plunge beneath that surface and the return to it with a new symbolic linguistic form in which we may perceive the conative-affective nature of human experience.

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1 July 1954.

J. Z. Fullmer has examined poetry with the aim of finding out how far science has gone in influencing poetic expression and thought. No definite conclusions are apparent from this article.

It is difficult to make any general statements about modern poetry; its sweep, ranging from the conservative and static to the symbolic and experimental, is far too wide. However, there are at least three things one can say with some assurance: (i) the poet is uneasy about modern science, (ii) poetry, on the whole, is definitely antiscientific, and (iii) no real fusion between modern science and poetry has taken place. The questions I should like to pose are these: What is the reason for the antiscientific attitude of the modern poet? Can a *rapprochement* between science and poetry be profitable?

The poet, in our day, must strive desperately to escape the general tendency toward mechanization and to him, machine and science being inseparable, science appears as a menace obscuring the deeper and real values in life. Although I am a scientist myself, I think that this is a valid point of view. On the other hand, the poet also, instinctively, as do many of us, equates the dire prospect of a thermonuclear future with progress in science and thus casts doubt on its value.

Of course, the modern poet has not been able to escape the impact of science. But it is a misconception, shared with Mrs. Fullmer by many scientists, to think that it is the task of poetry to interpret man's place in nature. This is the province of philosophy. The poet is preoccupied with images, form, and expression, and he takes his lesson from André Gide:

. . . puis il m'a dit que mon erreur était de partir d'une idée, et que je ne me laissais pas assez guider par les mots.

Good poetry follows this dictum. Even where parts of the scientific verbal armamentarium have been ab-

sorbed by some of the poets, real understanding frequently lags behind, as is well expressed by some of the quotations cited by Mrs. Fullmer. To give another example of this, consider a few lines from the poem "The Ratio of Rime to Language" from Karl Shapiro's *Essay on Rime* (Reynal and Hitchcock, New York, 1945),

... words are as lives,
Deaths and mutations, and the poet learns
Through search for life, the biology of rime.

One could quote many more, such as "chemic blood," "the very protoplasm of the tongue," "electrons deify a razorblade," and so forth. These and many more constitute rather unfortunate and unsuccessful attempts to make poetic language more scientific. These attempts are made for the following reasons: (i) the poet deliberately chooses scientific words that may give the language an infusion of freshness, and (ii) the poet, though reluctant, cannot escape the fact of the ever-increasing importance of science in our daily lives. This has not always been so. At one time the poet could quite well ignore science altogether, and it was such a feeling that prompted D. H. Lawrence to exclaim: "Whatever the sun may be, it is certainly not a ball of flaming gas." However, such an outspokenly antiscientific attitude is not possible any more today, and the poet is thus caught between his dislike of science and his realization of its importance. Thus it is not surprising that a few of the poets are trying, even if on the whole unsuccessfully, to achieve a fusion between science and poetry. Why do these attempts seem rather trivial? The answer lies partly in the afore-mentioned dilemmas, and partly in the inherent difficulty of the subject matter of modern science. It is this latter fact that explains why no latter-day Lucretius has attempted to write a more up-to-date *De rerum natura* (1st century, B.C.) in the light of recent developments in physics. It is no exaggeration to say that most poets, even the best of them, have been unable to crowd into their lives both a development as creative artists and serious attempts to become acquainted with science—even if we dispense here with the common, and perhaps not untrue, notion that one may possibly exclude the other. Is this state of affairs to be regretted? I do not think so. Scientific poetry is a bore.

I think that any poet, when taken into some corner, will admit that poetry and science are incompatible, that good poetry, in contrast to science, must remain vague, mystical, symbolic, antilogical, a place where white is black and love is hate.

The answer to the questions I have posed is thus probably this: No real fusion between modern poetry and modern science has taken place and none can be expected. And the likelihood is that science and poetry will diverge even further from now on.

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27 September 1954.

I wish it were possible for Mrs. Fullmer's article to reach more of the literary fraternity at large because of the implications of "source" in reference to our own age. I am a bit disappointed that she did not include Robinson Jeffers in her list. Jeffers has expressed, in some of the noblest passages of the English tongue, basic concepts of modern science. I refer to the vision of Onorio Vasquez in "The Loving Shepherdess," and the death of the eagle in "Cawdor." Such references to fundamentals of physical science are many in the works of this poet—whom Mary Austin once described to me as "the greatest poet since the Greeks." He always avoids the trite descriptive qualities of verse as well as the "heroic" adulations of science and scientists so common in the popular press.

An analysis of Jeffers' poetry from the scientists' viewpoint would be a worthy undertaking.

ANSEL ADAMS

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29 June 1954.

It is with pleasure that I join the arguments advanced by J. V. Hagopian in his communication, and I do it with the full awareness that what is here under discussion may concern problems more basic than the surface preoccupation with the science content of modern poetry would indicate. Hagopian has provided the occasion for a discussion that might help throw into sharper relief some of these more fundamental problems.

No great complexity of argument was presented in my paper of 18 June. Some literary critics say there is a considerable modern science content in modern poetry. A smaller number maintain that the modern science content in modern poetry is negligible. Since this difference of opinion involves science content, it would seem entirely proper for a practicing scientist to focus his attention on some poetry, to determine whether, in his opinion, there is or is not a modern science content.

Disagreements can arise in several ways. They can arise because the bases of the problem are not clearly defined, or because they are defined in different ways by those party to the quarrel. For this reason it was necessary to state immediately what is not meant by the modern science content of a poem, as well as what is meant by science content, to a practicing scientist. A disagreement can arise, too, because of the method or methods used to explore the problem. Methods are notorious because of the subtle and various ways they impose limitations on the answers obtained by their use; it is not at all unusual for the way a question is framed to dictate the form the answer takes. For this reason it was necessary to state what method would be employed—the method, confronting modern poems with modern science as one practicing scientist conceives it to be—and to point out, too, the limitations that such a method places on the conclusions drawn.

My conclusions were these: Some modern poetry does contain what to a practicing scientist is modern science. This, as Hagopian observes, is hardly news.

It was noted that the scientist does not always agree with the critic about what the science content of a poem is. Apparently this, to Hagopian, is news. It was also noted that Ezra Pound, a man evidently not without influence in shaping the idiom of modern poetry, urged the poets more than once to "look to the scientist" for certain kinds of information and techniques.

The ancient and alluring question about the function of the poet (or, for that matter, about the function of the scientist) was not raised. Because the statement of the problem of "Contemporary science and the poets" is independent of the question of the poetic function, it is possible to treat the poems simply as having existence. Logical extension of notions about the scientific content of poetry that carry with them, either directly or by implication, phrases like "all science" and "all poetry" leads easily to the statement that "the poets, a human kind of barometer, should be quick and sensitive to register the impact of each fresh discovery. . . ." Recently a critic [J. Isaacs, *The Background of Modern Poetry* (Dutton, New York, 1950)] established the usefulness of poetry to the historian of science by pointing out John Donne's usage of the phrase "magnetique force" some 20-odd years before the date of the earliest entry of this term in the *Oxford English Dictionary*. Such a statement seems to justify the notion that poets may be "quick and sensitive to register" impacts of discoveries. In this instance Donne acted as a "human kind of barometer." If this view in any way detracts from or nullifies the view of the function of the poet as *vates* (and Hagopian seems to think that it does), if this view in any way creates a muddle, one can only regretfully point out that it is a muddle of the critics' own making. Questions about the function of the poet are different, not only in degree from the problem in "Contemporary science and the poets," but also in kind. They are in fact *sui generis*.

It was by pursuing lines as straightforward as those described in the opening paragraphs that I earned the epithet "troublemaker" (and, what is more refreshing, a romantic one, to boot). Why it should be troublesome for a scientist to state what for him is the science content of a poem is difficult to see, especially in the face of the number of poets, critics, and estheticians who have stated what to them is science content. The fact that what some of these poets, some of these critics, and some of these estheticians call "science content" may occasion frowning scientists at least a raised eyebrow seems to trouble Hagopian not at all.

When Hagopian is puzzled by the restrictions that a scientist places on the term *scientific content* he is reacting in a way that is symptomatic of a strange situation. The criterions established to restrict the term *scientific content* were neither capricious nor irresponsible statements of what science is and of what science is not. Rather they attempted to be a thoughtful assertion of a position taken by many working scientists, stated by them in many ways. *Per se* the

assertions are of interest, for at one time or another in the history of science not all of them have been operative. For a nonscientist to reject the 20th century restrictions and the definition of science (itself a partial one) produces a predicament that can only be described as awkward. A scientist goes daily to the laboratory to carry out certain operations, some manipulative, some paper and pencil calculations. From the operations he reaches certain limited conclusions whose validity is subject to check, usually most efficiently by another scientist or group of scientists. On the other hand, the nonscientist does not enter into the operations; for him the conclusions may frequently appear only as Venus of miraculous birth. Because the careers—scientist or nonscientist—are entirely a matter of personal taste and choice, no praise or condemnation is awarded to either man for his choice of occupation; but this fact in no way permits the nonscientist to state dogmatically what the scientist is doing. The embarrassment, as well as the awkwardness, arises when the nonscientist wrongly attributes activities to the scientist. How best can the scientist cope with so perplexing a state of affairs? Short of nailing theses to his laboratory door, the scientist can continue to point quietly and firmly to the published journals as demonstrable proof of what he is doing. For a scientist the three listed points (and Hagopian has the listing only partly right) are statements of what is not included in the term *science*. Science is not philosophy. Science cannot permit the imputation of motives to inanimate objects. Science is not the products of applied science, or again, science is not a machine. But what then is science? There are nearly as many ways of answering this question as there are scientists. One of the ways is to state that science is an "attitude . . . related to the 'particular go of things.'"

It is necessary to be as clear on these points as is possible. Science is not philosophy. This does not say that scientists do not have a working philosophy—indeed, the three restrictions and the definition of science are themselves part of that philosophy. No one would be so foolish as to claim the absolute perfection of that philosophy, or its universality, but there is, to be sure, a certain hard core of belief that prevails among a good number of working scientists. The three statements of what science is not and the statement of what science is represent an attempt to define that hard core of belief.

Science does not permit the imputation of motives to inanimate objects. In no way does this limitation divorce the scientist from his own motives, and they operate in a very decisive way to determine the body of science. The scientist had a motive, first, in becoming a scientist. He may be, for example, of a practical bent of mind, he may be inquisitive, or he may find in science a satisfaction of his own esthetic needs. His particular bent partly dictates, too, the problems on which he will or will not work once he has achieved the status, scientist. Of equal importance are those motives that guide him in the ordering of his laboratory or computational findings, usually an esthetic problem within the framework of the experimental system.

Science is not the products of applied science; that is, science is not a machine. The broad tapestry that is the

history of science shows threads of many origins, not the least of which is applied science, and, on occasion, a machine. But since the chief scientific activity is the ordering of facts and the products of applied science come frequently only as the result of such ordering, it is not too wise, in the 20th century, to equate science with the machine.

Hagopian feels that the application to poetry of these three criteria was not self-consistent, and that it was done without an awareness of the meaning of the passages to which they were applied. The complaint would appear to have little basis in fact. The lines of T. S. Eliot, "knowledge of motion, but not of stillness" are striking to a scientist. Surely the metaphysical implications are obvious; that is, they can be apprehended directly from the text of the poem, without the guidepost provided by the literary critic, and without having to be read in conjunction with *Murder in the Cathedral*. The lines provide an excellent example for the statement that in T. S. Eliot the science does not stand away from his personal metaphysic. The point is a minor one, and I would make no attempt to belabor it were it not that the issues of this correspondence here broaden to include more than the surface preoccupations with "Contemporary science and the poets." Hagopian is quite clear on the nature of this issue, for he says: "Stillness here is symbolic of the eternal and spiritual unity of the universe . . . and if this is not a rejection of the 'concept of the very nature of scientific truth,' what is?" A statement of an "eternal and spiritual unity of the universe" does not constitute a rejection of scientific truth, for science, by definition leaves untouched these philosophic matters. To be sure, in the heyday of the scientific materialists there were those who felt that an acceptance of science meant a rejection of statements about "eternal and spiritual unity of the universe." Even in that heyday, however, some scientists recognized that the concomitance of the two views was not impossible, and today there is no uneasiness implied by the coexistence of the two notions. They are, indeed, peaceable bedfellows. Hagopian's refusal to recognize such a coexistence provides a striking example of the need for limiting a definition of science with the statement: science is not philosophy.

When a practicing scientist insists on rigorous use of the term *scientific* he is charged with being an intellectual provincial. The statement of Bush's about "scientific slaughter" would have been more acceptable had it read "airplanes fly all through poetry as a symbol of killing by men by means of a machine," or something to that effect. The statement made by Bush is a sample of the tendency to equate the products of applied science—that is, the machine—with science itself.

To a practicing scientist the quotations from the poem by Marianne Moore are of considerable interest and seem to have to do with science itself more than with applied science. In addition to an awareness of some of the properties of quartz the lines demonstrate something about the nature of scientific procedure:

"Repetition, with the scientist, should be synonymous with accuracy."

When Hagopian chooses to discuss the thought processes of the artist in contradistinction to the thought processes of the scientist he raises a point of considerable interest. He feels that "the creation of such forms of feeling [poems] requires mental processes far different from those employed by scientists." He maintains that it is "simply wrong" to assert that the "thought processes that are successful in" science may, "in some measure," be successful in poetry. The context of this assertion was supplied, in my "Contemporary science and the poets," in conjunction with the making of abstractions. Can the mental process that abstracts and frequently symbolizes properties of one situation be too remarkably different from a process that likewise abstracts and frequently symbolizes properties of another situation? The entire question (and it is a difficult one) of scientific and artistic creation, of scientific and artistic invention, of scientific and artistic discovery, is one that needs full exploration. It may be that Hagopian wishes to deny the scientist any part of creative endeavor, but surely he cannot do this in the face of modern science. C. N. Hinshelwood writes [*The Structure of Physical Chemistry* (Oxford, Clarendon Press, 1951)]

Science is not the mere collection of facts, which are infinitely numerous and mostly uninteresting, but the attempt by the human mind to order these facts into satisfying patterns. Now a pattern or design is not a purely objective function but something imposed by the mind on what is presented to it, as is seen in those pictures of piled cubes which can be made at will to appear in advancing or receding order. The imposition of design on nature is in fact an act of artistic creation on the part of the man of science, though it is subject to a discipline more exacting than that of poetry or painting.

And there the matter may rest, or nearly so. It has already been established that one literary critic has pointed out the value of poetry to the historians of science. The suggestion that this notion be broadened to include contemporary poetry and present-day science, thus providing an index of popularization, merely extends the idea. How does the poet use his science? He is not, of course, writing a scientific treatise. The science comes frequently as "an artifact of the poetic energy . . . used as one of the means for creating and heightening the poetic expression." Hagopian's metaphor (the one based on that of Hulme) hardly contradicts this view.

J. Z. FULLMER

4714 Fifth Avenue
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8 November 1954.

Publication of the communications on "Contemporary science and the poets" has been delayed because of the prolonged illness and convalescence of Mrs. Fullmer.

Determination of Xanthine Oxidase in Insects with Tetrazolium Salts

Xanthine oxidase is the enzyme that catalyzes the oxidation of the purine derivatives xanthine and hypoxanthine to form uric acid. This is a vital reaction in uricotelic animals such as insects. The flavin prosthetic group of xanthine oxidase is reoxidized by oxygen, by methylene blue, by the cytochrome system, and by other readily reduced chemicals. The experiments described here were performed to establish the principal sites of xanthine oxidase activity in insects and the desirability of substituting one of the several tetrazolium salts for the standard Thunberg technique using methylene blue in vacuum for the determination.

Samples of insect tissue were taken from nymphs of the American cockroach (*Periplaneta americana*), the yellow mealworm (*Tenebrio molitor*) in the larval stage, and 6th instar larvae of the southern army worm (*Prodenia eridania*). The tissues were dissected and washed free of adhering particles of other tissues or contained material and homogenized in a 2-percent solution of NaF in a suitable buffer with a detergent such as sodium lauryl sulfate or Triton X-100 added to liberate the enzyme from lipid particles. Pooled tissues from two to four insects were used for each experiment. Sodium fluoride at the 2-percent level proved to be the most effective bacterial inhibitor. The homogenates were either filtered or centrifuged, and the filtrate or supernatant was divided into two equal aliquots, diluted with equal volumes of buffer containing 800 μ g of neotetrazolium chloride [p,p'-diphenylenebis-2-(3,5-diphenyl tetrazolium chloride), or NTC]. The paired sets of tubes with and without xanthine substrate were placed in a suction flask and evacuated through the side arm. An incubation period of 1½ hr at 30°C gave satisfactory reduction with NTC. Tissue preparations incubated with tetrazolium chloride [(2,3,5-triphenyl tetrazolium chloride) or TPTZ] required an incubation period of 20 hr.

At the end of the incubation period the samples with NTC were extracted with a constant volume of water saturated n-butanol. The butanol layer was separated and the optical density for wavelength 520 m μ was measured spectrophotometrically. With TPTZ, reduction was stopped with trichloroacetic acid, and the red formazan was extracted with acetone, diluted to constant volume and determined for 480 m μ . The results indicate that tissue from the fat body and the gut reduced the dye 2 to 5 times faster than the controls, while tissues from the head and muscles showed an insignificant difference. These results are in general agreement with those of H. Liefert (*Zool. Jahrb. Physiol.* 55, 131 (1935)) who used a different analytic technique to examine the tissues of *Antheraea pernyi*. These data strengthen the hypothesis that the fat body of insects constitutes a principal site of intermediary metabolism and as such resembles the liver of vertebrates.

The tetrazolium salts TPTZ and NTC used in

vacuum were demonstrated to be satisfactory receptors in this reaction. The fact that these form stable colored compounds which can be extracted quantitatively gives their use distinct advantages over the methylene blue technique. Because of the shorter incubation period, the neotetrazolium chloride is the more satisfactory.

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1 October 1954.

Simple Multiple-Sample Dialyzer

In connection with studies utilizing continuous paper electrophoresis, it is frequently necessary to dialyze large numbers of samples. Figure 1 shows a simple apparatus that has been in use in this laboratory for approximately 2 years and has been proved to be satisfactory in every respect.

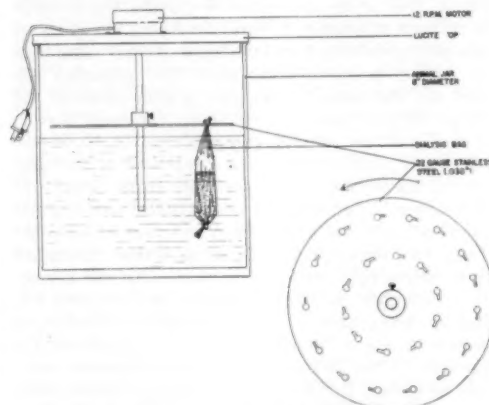


Fig. 1. Multiple-sample dialyzer.

Although Fig. 1 is self-explanatory, the following comments are offered. The knots that close the ends of the dialysis bags, made from the usual cellophane tubing, are passed through the "key holes" in the rotating plate and thus utilized to fasten the bag to it. A number has been stamped (not shown on figure) adjacent to each "key hole" for identification.

The amount of fluid, against which samples are dialyzed, can be varied and the height of the plate above the fluid level is then adjusted accordingly.

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11 August 1954.

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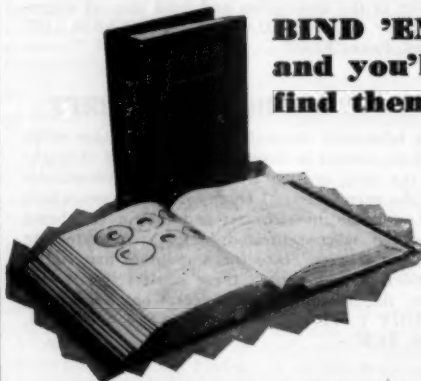
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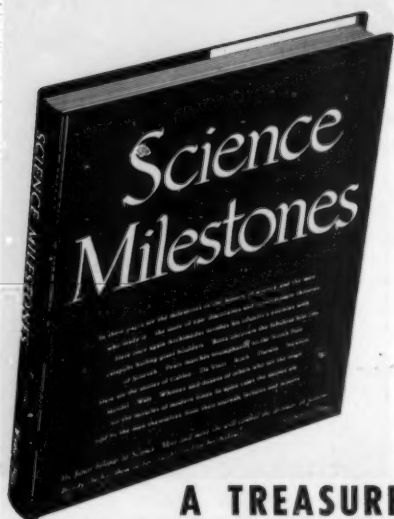


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Meetings & Conferences

December

- 26-31. AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, annual, Berkeley, Calif. (R. L. Taylor, 1515 Massachusetts Ave., NW, Washington 5.)
- 28-29. Linguistic Soc. of America, Detroit, Mich. (A. A. Hill, 1719 Massachusetts Ave., NW, Washington 6.)
- 28-29. Meteoritical Soc., Berkeley, Calif. (J. A. Russell, Univ. of Southern California, Los Angeles 7.)
- 28-29. Northwest Scientific Assoc., Missoula, Mont. (F. J. Schadegg, Eastern Washington College of Education, Cheney, Wash.)
- 28-30. American Economic Assoc., Detroit, Mich. (J. W. Bell, Dept. of Economics, Northwestern Univ., Evanston, Ill.)
- 28-30. American Meteorological Soc., Berkeley, Calif. (K. C. Spengler, 3 Joy St., Boston 8, Mass.)
- 28-30. American Physical Soc., Berkeley, Calif. (J. Kaplan, Dept. of Physics, Univ. of California, Los Angeles 24.)
- 28-30. American Soc. of Limnology and Oceanography, Berkeley, Calif. (B. H. Ketchum, Woods Hole Oceanographic Institution, Woods Hole, Mass.)
- 28-30. American Soc. of Zoologists, Chapel Hill, N.C. (R. T. Kempton, Vassar College, Poughkeepsie, N.Y.)
- 28-30. Archaeological Inst. of America, annual, Boston, Mass. (C. G. Yavis, Andover Hall, Francis Ave., Cambridge 38, Mass.)
- 28-30. Gerontological Soc., annual, Gainesville, Fla. (N. W. Shock, Baltimore City Hospitals, Baltimore 24, Md.)
29. Assoc. for Symbolic Logic, Pittsburgh, Pa. (J. Barlas, Rutgers Univ., New Brunswick, N.J.)
- 29-30. History of Science Soc., New York, N.Y. (M. Boas, Brandeis Univ., Waltham, Mass.)
30. Mathematical Assoc. of America, Pittsburgh, Pa. (H. M. Gehman, Univ. of Buffalo, Buffalo 14, N.Y.)
30. Soc. of General Physiologists, Berkeley, Calif. (J. B. Buck, National Institutes of Health, Bethesda 14, Md.)

January

- 8-8. Indian Science Congress Assoc., 42nd, Baroda, (ISCA, 1 Park St., Calcutta 16.)
- 11-14. American College of Surgeons, Inter-American session, Lima, Peru. (M. L. Mason, 40 E. Erie St., Chicago 11, Ill.)
- 11-14. Highway Research Board, Washington, D.C. (HRB, National Research Council, 2101 Constitution Ave., Washington 25.)
12. Astronomical Soc. of the Pacific, annual, San Francisco, Calif. (S. Einarsson, Leuschner Observatory, Univ. of California, Berkeley.)
- 12-15. World Symposium on Applied Solar Energy, Phoenix, Ariz. (M. L. Kastens, Stanford Research Inst., Stanford, Calif.)
13. American Genetic Assoc., annual business, Washington, D.C. (R. M. Cook, AGA, 1507 M St., NW, Washington.)
- 20-22. American Assoc. of Physics Teachers, New York, N.Y. (R. F. Paton, Dept. of Physics, Univ. of Illinois, Urbana.)
- 20-22. American Physical Soc., New York, N.Y. (K. K. Darrow, Columbia University, New York 27.)

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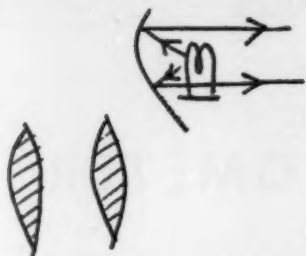
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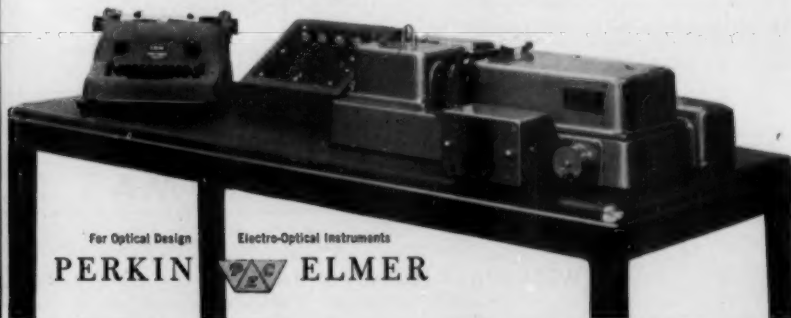
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9085-C.

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